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The Journal of Orthopædic Surgery

THE DIAGNOSIS AND PRE-OPERATIVE TREATMENT OF NERVE INJURIES.

BY MURRAY S. DANFORTH, MAJOR, M. C., U. S. A., PROVIDENCE, R. I.

This paper is based on a study of the patients suffering from nerve injuries who were treated in the Service of Colonel Sir Harold Stiles at the Edinburgh War Hospital, and it is due to his kindness that I am permitted to make this report.

Originality for methods is not claimed though many were developed independently. My object is to describe such features as were found valuable and necessary in the routine care of this class of injury. *The paper is divided into a section on Diagnosis,* which *includes the history taking and examination,* and a section on *Pre-operative treatment.*

THE HISTORY.

The usual medical history is taken and the following points especially noted:

1. *The date of the wound.*
2. *The character of the wound,* particularly how much suppuration occurred.
3. *The date of the healing,* showing the period of suppuration and how long the wound has been healed.
4. *Did the paralysis occur at the time, or did it come on subsequently,* as might be the case if the lesion were due to compression from scar or by the formation of callus.
5. *Whether the patient has observed if the paralysis is increasing or diminishing.*
6. *Whether the areas of anaesthesia are increasing or diminishing.*

THE EXAMINATION.

1. *A routine physical examination is made.*
2. *Examination of the special condition. This may be subdivided as follows:*

(a) *The location of the wounds or scars,* indicating whether by their position nerves might be involved by the scar or whether the missile in its course might have involved a nerve or nerves. This is helpful in distinguishing so-called functional paralysis from paralysis due to actual injury of the nerve.

(b) *The character of the scar:*

1st: Is it soft and non-adherent, or soft and adherent.

2nd: Is it indurated.

3rd: Does it suggest the probability of latent infection.

(c) *The condition of the joints in the affected extremity:* It is of much importance to describe briefly, but very accurately, the range of voluntary and passive movements in all the joints of the extremity, both proximal and distal to the site of the supposed nerve injury. Only in this way can a definite determination of subsequent progress be made.

(d) *The examination of the muscles* in the affected part: This is done *first by testing their voluntary power, and secondly, by testing their electrical responses.*

1st: The voluntary power:

For determining the presence or absence of voluntary power in muscles, a very considerable amount of experience is necessary, as much or more than for determining the electrical responses, but the information gained is of equal or greater value. The necessity of treatment, operative or otherwise, is chiefly dependent upon the function of the extremity, that is the voluntary control of the muscles. For the testing, the examiner must have an accurate knowledge of the location and relation of the muscles to be tested, of their actions and of the positions of the parts and of the movements by which contractions of the given muscles can be produced.

In making the test, the extremity is placed in such a position as to partly relax the muscle to be examined and

is supported, or forcibly held in that position by one hand of the examiner. The patient is then asked to try to make the movement that is known to cause contraction of the given muscle. So far as possible it is desired to get a movement that causes contraction only of that muscle. *The examiner watches for contraction in the muscle or tightening of its tendon, and also, of course, for motion imparted, but absence of the last is of no importance if there is definite contraction of the muscle, even though too weak to cause motion. In many instances, the determination depends upon palpation for contraction in the muscles and for tightening of the tendon. Contraction in the muscle means voluntary power. Tightening of the tendon means voluntary power unless it is due to change in the position of the joint from contraction of the opposing muscles.* (For example: Frequently in complete paralysis of the muscles supplied by the external popliteal nerve, the patient in attempting to dorsiflex the foot and toes will actually plantar-flex the foot and toes, and in so doing will tighten the tibial anticus and the long extensors of the toes. This source of error is eliminated by forcibly holding the foot and toes immovable and then tightening of the tendon of the tibialis anticus or the tendons of the long extensors of the toes can come only from shortening due to contraction of the muscle in question.) Sometimes, many attempts are necessary to determine the presence or absence of voluntary power. In case no contraction is seen or felt, the same test should be tried on the opposite extremity, so that the patient may understand exactly what is desired. If this does not result in demonstrating voluntary power on the affected side, the patient should be required to try to make simultaneously the same movement with both extremities. Sometimes this results in contraction of the supposedly paralyzed muscle. If it does not, the patient is required to make the movements simultaneously on the two sides, but against strong resistance on the normal side. In so-called functional cases, this will frequently result in contraction of the affected muscles. Another method is to ask the patient to make the desired

movement and then the examiner carries the joint through the movement. This is done several times, then the examiner at one stage in the motion quickly makes the opposite motion. In functional cases, the stimulus of this sudden stretching usually will cause the muscle to contract.

2nd: The testing of the response of the muscles to electrical stimulation:

For this purpose, an ordinary combined battery was used,—the limit of the galvanic current being what could be obtained from forty dry cells. By appropriate switches, the current could be changed from faradic to galvanic, and from galvanic to faradic as desired and without moving the electrodes. *The response to faradism is tested first.* The large (indifferent) electrode is placed on the back over the sacrum or between the shoulders. The motor point of the muscle is sought with the small electrode. The response, or lack, is noted and comparison is made by testing the same muscle of the opposite extremity. The amount of current is increased gradually to the limit of tolerance, unless response is obtained earlier. *If no response, the current is changed to galvanism. With galvanism, the character of the contraction is the important feature. It may vary all the way from the quickly appearing sharp contraction of a normal muscle to the slowly appearing slow contraction and slow relaxation of the muscle whose nerve supply is cut off. This delayed appearance of the contraction and slow contraction and slow relaxation are the points to be noted. Polar changes were, so far as we could determine, of no value in determining the extent of the nerve lesion.*

For the recording of the voluntary power in muscles and the electrical responses, and for help in ascertaining the extent of the nerve lesion, special so-called muscle charts were devised, giving for the upper extremity, the muscles supplied by the musculo-cutaneous, the musculo-spiral, the median and the ulnar nerves in the order in which their branches are given off from the parent nerve, and for the lower extremity, a chart was made of the muscles supplied by the sciatic and internal and external

popliteal nerves. Following the muscle column were columns for recording the voluntary power, the response to Faradic stimulation and to Galvanic stimulation, and a column for remarks. Thus

For the upper extremity:

		Vol. Power	Far.	Gal.	Remarks
Musculo-cutaneous	Biceps				
	Brachialis				
Musculo-spiral	Triceps: Outer head				
	Triceps: Long head				
	Triceps: Inner head				
	Brachio-radialis				
	Ext. Carp. Rad. Long				
	Ext. Carp. Rad. Brev.				
	Ext. Comm. Dig.				
	Ext. Min. Dig.				
	Ext. Carp. Ulnar.				
	Ext. Os. Meta. Poll.				
	Ext. Poll. Long.				
	Ext. Poll. Brev.				
	Ext. Indicis				
Median	Pron. Rad. Teres.				
	Flex. Carp. Rad.				
	Palmaris Long.				
	Flex. Dig. Sub.				
	Flex. Dig. Prof. (1				
	Flex. Dig. Prof. (2				
	Flex. Poll. Long.				
	Abduct. Poll. Brev.				
	Opponens Poll.				
	Flexor Poll. Brev.				
	Lumbricales (1				
	Lumbricales (2				
Ulnar	Flex. Carp. Ulnar				
	Flex. Dig. Prof. (3				
	Flex. Dig. Prof. (4				
	Abduct. Min. Dig.				
	Interossei				
	Lumbricales (3				
	Lumbricales (4				
	Adduct. Poll.				
	Flex. Poll. Brevis				

FIG. 1.

FIG. 2.

No. 407110, Sgt. Levy; admitted July 29, 1918; complete musculo-spiral paralysis.

Fig. 1 shows extent of drop wrist and areas of anaesthesia, Aug. 15, 1918.

Fig. 2 February 14, 1919, three months after operation, showing improvement and ability to extend the hand on the wrist.

For the lower extremity:

		Vol. Power	Far.	Gal.	Remarks
Sciatic	Biceps				
	Semi-membranosus				
	Semi-tendinosus				
External Popliteal	Peroneus Longus				
	Peroneus Brevis				
	Ext. Com. Digitorum				
	Tibialis Anticus				
	Ext. Prop. Hallucis				
	Peroneus Tertius				
	Ext. Brevis Digitorum				
Internal Popliteal	Gastrocnemius				
	Soleus				
	Tibialis Posticus				
	Flexor Long. Digitorum				
	Flexor Prop. Hallucis				
	Abductor Hallucis				
	Flexor Brevis Digitorum				

Symbols were used to denote weak power, fair power, normal power, no power, and for the electrical testing, weak response, fair response, good response, and no response. In this way a complete examination of the muscles could be made and rapidly recorded, and there was no possibility of muscles being overlooked.

(e) *The examination of the Cutaneous Sensibility:*

Two tests were used, sensibility to cotton and to pin prick. It is essential that the patient not be allowed to look at the part being tested. The area is shaved if needed. The testing is done by going from the anaesthetic or hypo-aesthetic area to the normal area. Cotton is first used and the area of anaesthesia marked out with a black wax pencil. Then the area of analgesia is marked out with a red or other colored pencil. *For recording the changes in sensibility, the charts prepared by Col. A. M. Patterson of the Imperial Medical Service and Professor of Anatomy at the University of Liverpool, were used.* These were helpful in that not only they showed the area supplied by the nerves but showed the root distribution of the nerves.

FIG. 3.

FIG. 4.

No. 709874, Pvt. Gayton; wounded Feb. 22, 1917; exploration musculo-spiral July, 1918; ends could not be approximated.

Fig 3, November 10, 1918, before operation; note drop wrist in left hand and inability to abduct thumb as compared with the right hand above.

Fig.4, April 9th, following, shows improvement in wrist, fingers and thumb.

(f) *Description of the Trophic Disturbances:*

The points noted were the changes in the color and other appearances of the skin, as scaliness, sweating, dryness, the changes in the nails, and the nutrition of the muscles. Frequently an ulnar or a median lesion could almost be diagnosed from inspection of the part alone.

(g) *Distal tingling:*

There has been doubt about the value of this sign but in certain instances in which there was no other evidence of physiological continuity of the nerve a reasonable assurance of its physiological continuity was found in this sign. Caution must be used in the testing, however. We found it essential to begin far distal to the site of the injury of the nerve and approach the site slowly along the course of the nerve. To avoid the danger of the patient's imagining that he felt tingling we only accepted it as positive evidence in cases where the area localized by the patient as the place of tingling was included very definitely in the area normally supplied by the nerve. Gradual extension distally of this phenomenon was an added help.

The Diagnosis.

The examination outlined above furnished the basis for the diagnosis and determined the treatment. Single examinations were never accepted as sufficient to indicate operative measures, except possibly the correction of deformities. As a rule, one examiner made all the tests. In this way it was possible for him to note at once any apparent discrepancies between the results of the voluntary power tests and the electrical responses, or between changes in muscle power and changes in cutaneous sensibility. In case of apparent discrepancy, the tests were gone over until the discrepancy was removed, or the reason for it ascertained, if possible.

Complete loss of voluntary power with loss of faradic excitability and with slow galvanic response, associated with anaesthesia and analgesia, over the area supplied by the nerve and absence of distal tingling distal to the site of injury, means physiological loss of continuity in the nerve trunk. Only repeated

FIG. 5.

FIG. 6.

No. 10916, Pvt. Hearle; wounded April 23, 1915; July, 1915, operation musculospiral not united. Tendon operation August, 1918.

Figs. 5 and 6 show improvement in the degree of flexion-extension of the wrist and abduction of the thumb, before and after operation.

examinations can indicate the probability of anatomical loss of continuity, or that recovery will not take place.

Voluntary power was frequently found to be present in muscles showing no Faradic response with one electrode only applied to the muscle. Probably with a very strong current and both electrodes on the muscle, contraction could have been produced, but certainly not the normal response.

In certain cases no voluntary power would be found in muscles showing good faradic response, but almost invariably at a subsequent examination, power would be shown. This condition occurred in the so-called functional paralysis,—a condition which was usually found to yield quite promptly to appropriate treatment.

The general working rule was to wait six weeks to two months after complete wound healing before operating, and during that time the patient had two and usually three complete examinations. In addition, a voluntary power examination was made each week. If at the end of six weeks or two months, it was found there was no change in the condition and that the examination showed a complete loss of physiological continuity, or incomplete but unchanged loss, operation was done, if the amount of disability warranted it. In a few instances in which the patient had been under observation previous to the wound healing and sufficient evidence was at hand to justify diagnosis of complete division, the operation was done less than six weeks after the wound healing. This was, however, only in exceptional circumstances. In our work the condition at operation was almost invariably found to be more extensive than the clinical examination would indicate.

The Pre-operative Treatment

The interval of six weeks or two months between the time of wound healing and the possible operative treatment was employed in improving the nutrition of the muscles, correcting any deformities and restoring flexibility of the joints in the affected extremity. The necessity of this preliminary treatment of correcting deformities and restoring movement in joints when possible was shown by a study of some of the earlier cases which were operated upon without any previous preparatory treatment.

FIG. 7.

FIG. 8.

No. 201383, Pvt. Tucker; wounded October, 1917; nerve operation March, 1918; tendon transference December 9, 1918.

Fig. 7 shows function four months after operation.

No. 690865, Pvt. Hopkinson; wounded October, 1917; tendon operation September, 1918. Extensor ossis metacarpi pollicis to the flexor digitorium sublimis flexor carpi ulnaris to the flexor digitorium profundi.

Fig. 8 shows possible function seven months after operation.

If no deformities were present, the muscles were protected from stretching by appropriate splinting. This was found to be a very important feature and its lack was often sufficient to retard or prevent restoration of power in the muscles, and further, it was found necessary to maintain this relaxation constantly. This was perhaps especially so in circumflex, musculospiral and external popliteal paralysis, but undoubtedly is nearly as necessary in all nerve injuries.

In addition to the protection given by splinting, the muscles were treated by hot soaks, or whirlpool baths, followed by massage and either active or passive motions, and electrical stimulation.

In cases in which deformity was present, the *deformity* was corrected. *The most common deformities found* were adducted shoulders, palmar-flexed wrists and plantar-flexed feet. The shoulders were usually corrected by manipulation under an anaesthetic and application of a plaster of Paris jacket with an arm piece holding the arm in 90° of abduction and slight external rotation. The top of the arm part was removed to allow of treatment. The palmar-flexed wrists were corrected by manipulation under an anaesthetic and application of a plaster of Paris cast maintaining the dorsi-flexion. After ten days to two weeks the cast was removed and active stimulative treatment begun. The plantar-flexed feet were corrected by manipulation under an anaesthetic with or without lengthening of the tendo Achillis as the condition required.

The restoration of flexibility of joints was perhaps the most difficult part of pre-operative treatment and the finger joints the most difficult of all joints. For these small joints various methods were tried. Massage and hydrotherapy were found successful in a few instances. Forcible manipulations with or without anaesthetic were found helpful in only a very few instances, and much more often rendered the joints stiffer. Finally elastic traction was tried; at first pulling in direct flexion if it were that the fingers were fixed in extension. This was helpful in a certain number of cases, and never made the condition worse. Then elastic traction in the direction to first stretch the joint capsules was tried. This was found a great advance. One of my colleagues, Lieutenant-Colonel Baldwin, devised a very successful splint to apply this traction, and also splints were made from plaster of

FIG. 9.

FIG. 10.

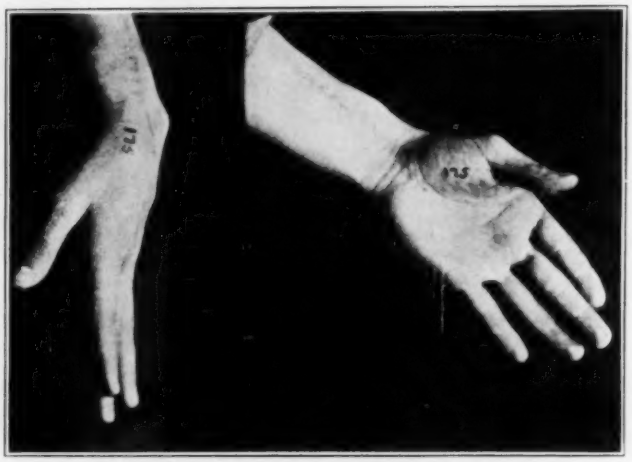


FIG. 11.

No. 454818, Pvt. Cousineau; wounded March, 1917; tendon operation November, 1918; transference of flexor carpi radialis to the extensor digitorium communis and extensor secundum internodii. Also the palmaris longus to the extensor primas internodii pollicis and to the extensor ossis metacarpi pollicis.

Figs. 9 and 10 show condition November 6, 1918, with drop fingers and wrist and adducted thumb.

Fig. 11 shows condition on March 5, 1919, three and one-half months after operation. This patient always had voluntary dorsiflexion of hand. Tendon transference was to fingers and thumb. Improvement in extension is shown by lower figure.

Paris with a racquet shaped wire attached. *The traction was applied by strips of adhesive on the sides of the fingers to which elastic bands were attached, and these in turn attached to the splint. The pull was at first always in the line of the deformity and then gradually changed as the motion in the joints permitted. Sometimes metacarpo-phalangeal joints which had been fixed in hyperextension for months would be completely flexed in two or three weeks, but usually several months were required.* It was found essential to have massage and passive motion used daily in association with the treatment. Active movements were always used if there were any power in the muscles controlling the joints. After the metacarpo-phalangeal joints had become flexible, the adhesive strips were applied only over the two distal phalanges and work begun on the proximal interphalangeal joints. These joints usually gave much less trouble.

In a few instances, similar traction splints have been used for deformities and stiffness of toes, and in the few instances tried have been successful. In other joints restoration of motion was less essential to successful nerve work perhaps, but every attempt was made to gain flexibility.

RESUME.

The diagnosis depends upon careful history taking and careful examinations made at frequent intervals and so accurately recorded that any change would be shown at once by a comparison of the different sets of records. The question of operation was decided by a study of these records. Absence of improvement during a period of two months following complete wound healing was held to be an indication for exploratory operation if the motor loss, cutaneous sensibility loss, trophic disturbance, or presence of pain constituted an actual disability.

The special points about pre-operative treatment learned in our study were the necessity of protective splinting, correction of deformities, and restoration of flexibility of joints, especially the smaller joints of the hand.

OPERATIVE TREATMENT OF PARALYTIC CONDITIONS OF THE UPPER EXTREMITY.

ARTHUR STEINDLER, M. D., F. A. C. S., IOWA CITY, IOWA

From the viewpoint of functional grouping of affected muscles three types may be distinguished in spinal paralysis of the upper extremity.

1. The shoulder type, involving deltoid, supra and infraspinatus muscles; inability of elevation and outward rotation of the shoulder.

2. The shoulder and elbow type involving also the coracobrachialis, brachialis anticus muscles, triceps, the supinators and often also the extensor muscles of the forearm; loss of shoulder action and of flexion in the elbow; pronation contractures.

3. The general type, involving additionally the muscles of the forearm and wrist more often and more completely the extensor groups, and very frequently the intrinsic muscles of the hand.

In general, fingers and wrist much more frequently escape paralysis than shoulder and elbow.

From the viewpoint of radicular distribution, group 1 represents 5th and 6th cervical root, group 2 the 5th, 6th and 7th cervical root, group 3 the 5th cervical to the 1st dorsal root.

But inasmuch as the spinal motor roots are not representative of the grouping of the motor nuclei in the anterior horn one must look to the topography of the motor cell groups for an answer to the question regarding the functional relationship of paralyzed muscle groups. Some knowledge of individual motor nuclei in the anterior horn has been gained by the studies of Sano, von Gehuchten, A. Bruce and others. We know that the cell columns appear on cross sections in typical clusters, a anteromedian portion representing the dorsal and thoracic muscle groups, while the columns for shoulder, elbow and hand appear successively in columns occupying the antero-lateral, lateral, postero-lateral and central fields of the anterior horn. That these topographical arrangements are really based upon functional relationship of neighboring motor columns and that they, therefore, represent motor centers of the lower order, we have reason to believe not only from study of the cervical, but also

of the better known lumbo-dorsal intumescence of the spinal chord.

Such pathological changes, therefore, may result in clinical paralysis of coordinated muscle groups, not conforming to either peripheral or radicular distribution. Consequently in attempting to reconstruct the function surgically or otherwise one is often confronted by a multiplicity of deficiencies which, though co-ordinate among each other, call for a number of distinct operative interferences.

The essential requirements of function of the upper extremity are:

Active abduction, or a position of abduction of the shoulder, the ability of flexion in the elbow, the ability of pronating the forearm, of hyperextension, either active or passive, of the wrist and active flexion of the metacarpo-phalangeal joints, free play of the fingers and the power of opposing the thumb to the fingers.

The problems considered are:

1. To procure abduction of the shoulder.
2. To procure position of flexion in flail elbow.
3. To overcome flexion contraction in the wrist and substitute for it stable hyperextension.
4. To overcome the claw hand deformity, and secure flexion motion of the metacarpo phalangeal joint.
5. To procure for the thumb power of opposition and active extension.

I. Flail Shoulder.

Neither the study of the literature, nor any of his own attempts have been able to convince the writer that there exists a reliable and practical method of tendon transplantation in cases of flail shoulder. Here the loss of the deltoid, supra and infraspinatus is often accompanied by subluxation of the humerus. If the triceps muscle is intact, stabilization of the head of the humerus in the socket can be accomplished and some patients are able to effect some abduction of the shoulder by contraction of this muscle, which presses the head against the glenoid cavity. Others are able to do so by sharply flexing the elbow, and in this way bringing about tension of the triceps muscle. The shoulder movements may then be governed by the

trapezius muscle. The indication in cases of flail shoulder is arthrodesis. We have not found it necessary that it be a complete arthrodesis, however.

Pre-operatively muscle development of the shoulder muscles is obtained by gymnastic.

Operative technic: Horseshoe incision circling the acromion, the outer end of the incision being extended over the spine of the scapula. The deltoid muscle is isolated. The acromion is cut

FIG. 1
Case M. C.—Arthrodesis of Shoulder

FIG. 3
Case J. T.—Elbow Plasty

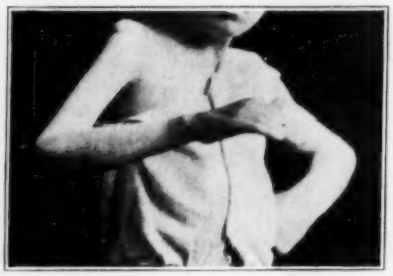


FIG 2
Case M. C.—Observation 9 Months

FIG. 4
Case J. T.—Observation 15 Months

through ½ inch from its edge and the deltoid with the acromial insertion is turned downward. This approach gives good access to the shoulder joint. Part of the head is resected and the glenoid fossa is reamed out. The raw bone surfaces are united with wire or strong cat-gut sutures. The capsule is reefed and closed.

I found it practical to transfer the deltoid flap backward toward spine of the scapula, forcing the head of the humerus forward. This seems to give the trapezius a better control of the shoulder movement.

The shoulder is held in platform splint at right angle for 4 months.

Number of cases operated 4.

Average age of patients 15 years.

Average duration 6 years.

Average time of observation after operation 8½ months.

Result: Good (active elevation from 75 to 90 degrees) 3 cases. Fair: (active elevation 45 degrees) 1 case.

II. Flail Elbow

The problem of flail elbow causes considerable difficulty as the arthrodesis cannot be undertaken in children under 14 or 15 years of age and is even then doubtful. In regard to silk ligament fixation of the elbow, the author has had no experience and cannot judge the applicability of this method. In a number of cases of flail elbow I have been able to apply the following operative method:

1. Incision is made on the inner side of humerus around the internal condyle. The ulnar nerve is exposed and drawn backward. From the muscles arising from the inner condyle, a flap is very carefully dissected off subperiosteally to the length of 1½ inch. This is usually as much as may be freed without interfering with nerve supply of these muscles. This flap is then, under flexion of the elbow, fastened to the median portion of the intermuscular septum 2 inches above the elbow joint.

2. To this I added lately a corresponding incision on outer side of the arm dissecting the extensors carpi radiales, freeing them from their origin and fastening them in similar manner 2

inches higher up, to the outer intermuscular septum. It is also advisable to identify the musculospiral nerve and to retract it backward.

This operation will cause the flexors and extensors of the wrist to act as flexors of the elbow but it must be understood that the flexion power of these muscles is very limited and that only those cases should be selected in which the muscles mentioned are not or only very slightly weakened.

This method has been used in connection with arthrodesis of the shoulder or alone in ten cases, one of which is too recent to be reported. Of the remaining 9 cases:

FIG. 5
Case B. R.—Arthrodesis of Shoulder Plus Elbow Plasty.

FIG. 7
Case L. M.—Arthodesis of Wrist

FIG. 6
Case B. R.—Observation 6 and 8 Months.

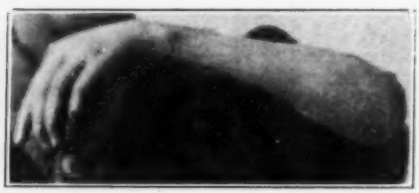


FIG. 8
Case L. M.—Observation 12 Months

Average age of patients 10 years.

Average duration 3 years.

Average observation after operation 12 months.

Result: Good in 5 cases, active flexion of the elbow to or above the horizontal.

Fair (distinct muscle action) 1 case.

Poor (slight or no muscle action) 3 cases.

Patient is placed in a plaster cast for 2 months and then must wear, for at least 6 months or more, a splint with a stop lock not allowing extension over 90 degrees.

III. Drop Hand and Flail Wrist.

In many cases the question of stabilizing the wrist had to be taken up, either on account of loss of active muscle power or on account of contractures. The necessity of the extension position as well as that of stabilization in this joint is now well enough established. The advantages of a fixed wrist over a flail one will not seem strange when one remembers the splendid results obtained by stiffening operations on the ankle. In cases of flail elbow where some of the flexors and extensors of the wrist are to be made available for elbow action, stabilization of the wrist is also one of the mechanical requirements.

Technic: A short incision is made over the dorsum of the hand between the extensor pollicis longus and extensor indicis. One proceeds directly to the carpal joint without interfering with tendons or their sheaths. The joint is opened, part of the radius and of the scaphoid are scooped out. Capsule and fasciae are sutured and the wound is closed, the wrist being placed at once in a cock-up splint.

The result is not complete arthrodesis but rather very limited motion of the wrist from about 30 degrees extension to 10 degrees.

Eight cases were operated. Five paralytic and three spastic.

Average age of patient 10 years.

Average duration 7½ years.

Average time of observation after operation 11 months.

The arthrodesis held in all cases. The functional result was good in 5 cases, fair in 2 cases and poor in 1 case.

Among the spastic cases two had extreme spastic flexion contractures.

The cases are subjected to prolonged muscle educational after-treatment.

IV. Tendon Transplantation.

With the limited amount of muscle power available in infantile paralysis we found it advisable in almost all cases, before transfering power from the flexors to the extensors of the fingers, to secure first stability of the wrist by arthrodesis. Tendon transplantation to procure extension of the fingers was done in 6 cases. In 5 cases the interosseous route was used in carrying the flexor carpiulnaris forward to the extensor tendon. The flexor carpi radialis, when used, was carried around the outer side of the radius as advised by Sir Robert Jones.

Operative technic: In bringing the flexor carpi ulnaris through the interosseous space from a volar incision one should be careful to dissect the ulnar nerve and artery and retract them

Fig. 9
Case H. W.—Tendontranspl.
(Interosseous)

radially. The tendon of the flexor carpi ulnaris is brought through the interosseous membrane at the upper border of the pronator quadratus. The tendon is sutured lengthwise in two strips to the extensors of the fingers.

Six cases were operated on, the interosseous transplantation being done in five. One case died of influenza in less than one month after operation. Of the remaining five cases:

FIG. 10
Case H. W.—Observation 10 Months

Average age of patients 16 years.

Average duration 6 years.

Average time of observation after operation 12 months.

Result: Good in 3 cases, fair in 1 case and poor in 1 case.

Four cases were cases of infantile paralysis and 1 of peripheral paralysis.

In three cases the arthrodesis of the wrist accompanied the interosseous tendon transplantation.

V. FLEXOR PLASTY.

Loss of active opposition of the thumb seriously interferes with the function of the hand. If the long flexor of the thumb is active a good deal of improvement can be obtained by a simple tendon plasty. The flexor tendon is split longitudinally and the outer half is carried around to the outer side of the base of the basal phalanx of the thumb and is there fastened. Within a few weeks the point of the thumb can be brought in contact with ulnar side of the hand and little finger.

Of six cases operated three were cases of infantile paralysis, 2 of Volkmann's paralysis and one of peripheral paralysis.

Average age of patients 14 years.

Average duration 6½ years.

Average time of observation after operation 11 months.

Result: Functional result good in five, fair in one.

In most of the cases this operation was preformed in addition to other work on the hand and forearm.

VI. In a similar manner lack of extension of the thumb interferes with function of the hand in certain groups of spastic cases. The thumb not being sufficiently checked by extensor action when the fist is closed, is thrown under the fingers. In these cases use was made of the method of Mayer and Biesalski, by taking the extensor of the index finger as a check to the flexors of the thumb.

Six cases were operated. All were cases of spastic hemiplegia.

Average age of patients 8 years.

Average duration 7 years.

Average time of observation after operation 7 months.

Result good in five cases, fair in one case.

VII. Flexion contracture of the wrist in main en griffe as found in cases of spinal paralysis and Volkmann's contracture was treated by flexor plasty in some cases, and by the cock-up

FIG. 11
Case J. B. — Thumb Extensor Plasty.

FIG. 12
Case J. B. — Thumb Extensor Plasty.

FIG. 13
Case L. D.—Observation 18 Months.

splint in others. As far as the claw hand deformity is concerned no method has been found superior to that originated by Sir Robert Jones. The writer has used a short cock-up splint covering the palm of the hand.

For the correction of the hyperextension position of the metacarpo phalangeal joints, many modifications have been devised. In the spint I have been using lately the principle of traction is applied in two separate systems. One acts upon the basal phalanges to overcome the hyperextension in the metacarpo phalangeal joints and the other upon the end phalanges of the fingers to overcome the flexion contracture of the middle and end

FIG. 14
Case J. B.—Observation 6 Months

phalanx. Traction is made by means of leather straps sewed to a well fitting leather glove. The straps are fastened to sliding bars which allow more or less divergence of the traction systems. The bars are carried by an upright arising at an angle from the upper end of the cock-up splint.

In most of the cases reported a combination of operative procedures had to be carried out. It was very evident that where the operation succeeded in regard to its original purpose it also

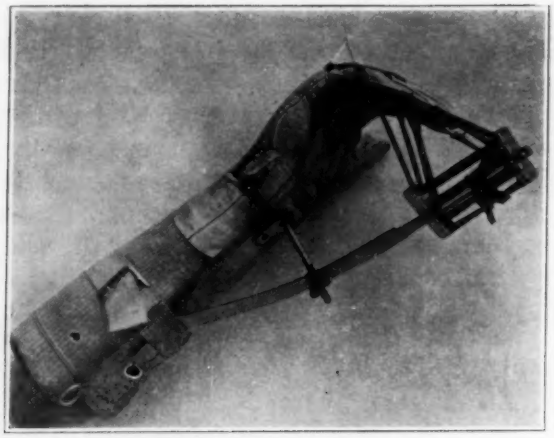


FIG. 15
Cockup Traction Splint.

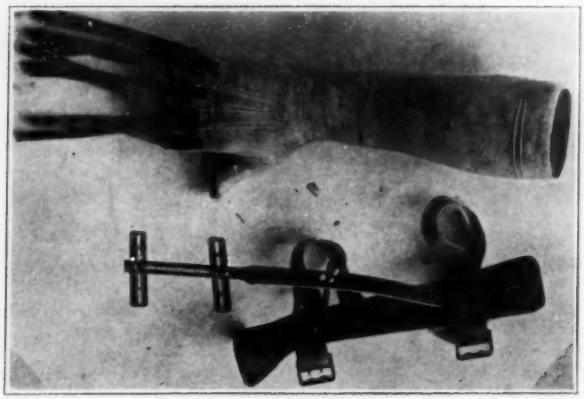


FIG. 15a.
Cockup Traction Splint.

decidedly benefited action in neighboring joints. For instance flexor plasty of the elbow, combined with arthrodesis of the shoulder in three cases showed a much better functional result than in cases where arthrodesis of the shoulder was not carried out, though indicated. Likewise, the writer feels that if arthrodesis of the wrist had been carried out in several cases of elbow plasty in which it was omitted the results for the elbow would have been better.

FIG. 16
Case R. W.—Splint Treatment

FIG. 17
Case R. W.—Observation 2 Months

As far as transference of power from flexors of the wrist to extensors of the fingers is concerned the writer is convinced that, at least in cases of spinal paralysis, the best results can be obtained only if stabilization of the wrist joint in extension position is secured. In the majority of cases this can be obtained only by arthrodesis.

DISCUSSION OF DANFORTH AND STEINDLER PAPERS

DR. CLARENCE L. STARR, of Toronto, said that the subject of nerve lesions and paralytic conditions resulting from them was an intensely interesting one, and it had proved one of the most serious of war disabilities. Experience would now have to be applied to civil practice. War practice was now a post mortem condition which he hoped the present generation would not have to pass through again. The proper time for operation on nerve lesions was of great importance. They were now studying results upon 450 to 500 cases of nerve suture and nerve separation from scar, and were attempting to find out what they had succeeded in doing. The results were very interesting. Early cases were those of bullet wounds and machine gun wounds, which generally healed within two weeks, but left complete separation of the nerve. These were operated on early and formed a large percentage of complete recoveries and restoration. Others that were found to be septic and were brought home for treatment 18 months or 2 years after the injury, showed a very small percentage of recovery, so that they were almost hopeless. One had to choose the best time to operate. Dr. Kidner at the A. M. A. said that a large percentage of these men would recover if left alone, but many of them would not come anywhere near approximation, even if left till the crack of doom. Dr. Kidner placed emphasis on Tennell's sign. The speaker said he was not sure that this was a good sign. Irritation of the proximal end often would cause a tingling, also irritation of the nerve distal to the injury, would cause formication, in cases with widely separated ends, so that the sign was not altogether reliable. Operation should not be delayed when it was found that the muscle power was doing down, as tested by faradic and galvanic stimulation. Operation done with these indications usually showed what was expected. The orthopedic man worked hand in glove with the neurologist, and insisted on his checking up results to ensure accuracy. When one read such accounts as those which stated that 12 to 16 inches of nerve gap had been bridged over, with recovery, one could only say that the writers were a very high grade type of what the men in the ambulance service called "liers." The speaker had never seen a satisfactory case of nerve bridging, with ultimate recovery. The question of bringing end to end in nerve operation was very difficult. One could get recovery in nerves with purely motor function like the musculo-spiral and the sciatic. It seemed occasionally as if there were rotation of the nerve and that the axis cylinders found their way from motor areas to sensory areas. Elsberg had described such types of bundles in the distal end of the nerve, and showed that one could pick out fasciculi in the upper end and compare them with those in the lower end. A piece of shrapnel might twist a nerve a number of times, and it was almost impossible to get approximation of the proper fibers. One had to trust in the Lord and join the ends. Best recoveries were seen in the sciatic, the median and the musculo-spiral. In the upper extremity one had a good substitute in muscle transplantation, particularly in the musculo-spiral, where one only had to overcome gravity. With the musculo-spiral injury one could transplant muscles and make a useful hand. The pronator radii teres could be taken from its insertion and inserted into the extensors of the wrist, the palmoris longus to the extensors of the thumb, the flexor carpi radialis to the extensors of the fingers, through the fat and subcutaneous tissues. Recoveries in two months were almost equal to recoveries of the musculo-spiral in eight or ten months. Pictures would show voluntary extension of the hand, wrist and thumb. The question was not so much what had been done, as what was the final result. Tendon transplantation was so satisfactory, that one did not feel badly if the musculo-spiral was separated. The slides would show the method of tendon transplantation.

DR. SIDNEY M. CONE of Baltimore said he had prepared a paper on the diagnosis and prognosis of peripheral nerve injuries. Most of his material had

a bearing on what had been said. To combine all in a critical review would be best done by referring to the Journal of the A. M. A. May 24th, in which J. S. Horseley reviews biology in its practical application to surgery. He emphasized the necessity of co-operation between the laboratory worker, the surgeon and clinician. There is no doubt that "team work" in surgical, orthopedic and neurological fields would aid greatly in solving the problems. Cone thought that some things had been too emphatically said. He noted Col. Starr's statement that one could not successfully graft peripheral nerves. There was a good deal of good clinical and laboratory work which would refute that broad statement. The work of Nageotte had to be considered, with some reserve on the surgical side, but he had shown that nerves could be successfully united. He used live and "fixed" nerve between the ends, and ultimately decided that nerve preserved in alcohol made the best graft. One should keep one's mind open at the operating table, and learn more about how nerve grows and what appearances indicate. The speaker said he studied 500 cases at the Alderhey Hospital and in the laboratory of the University of Liverpool. Captain Alexander would add his clinical findings to the work, so that the link between the clinical, the surgical and the laboratory work could be established. The anatomical changes both microscopical would then be better appreciated. Although a great deal of work had already been done on this subject, the speaker said he was not ready yet to make any dogmatic statements, such as had apparently been deduced from his writings. He believed that there were other methods of nerve growth than those commonly seen, i. e., from the central end. He had no doubt that the proximal end, surrounded by Schwann's sheath cells, had a better chance to grow. He felt also that nerve formation might take place in the distal ends or the scar formation of Déjérine. There was good reason why there should be more growth from the proximal end, than from the distal end of it retains connection with the trophic center. How then did the nerve find its way to the periphery? A plea should be made for a more complete study, with open minds, upon this subject. Nerves caught in a cellular embryonic state might produce growth which simulated per primam growth. Growth under pathological conditions is different. Often nerves had been seen showing wild growth through the sheath after operation. Scar tissue, however, prevented this. Even with foreign bodies, symmetrical nerve bulbs were seen, growing quite close up to the foreign body. There was also the question of the blood supply to the nerve. In a case where the musculo-spiral and ulnar nerves had been completely severed for months, the amputated arm was studied, and a growth of new nerve was found down to the wrist, not complete, but a suggestion of an attempt to form new nerve all the way along and some adult nerve with funnels. In another case nerve callus was seen, and a half inch above the site of operation for severed tendons. In following it down, he found the median nerve half cut through. Recognition of the pathological material led to a proper interpretation of the clinical condition.

Dr. S. L. McCurdy said that he had placed himself on record in the paper read before this society two years ago upon the subject of musculo-spiral surgery. Since that report a number of cases have presented themselves in which the brachial plexis or its branches had been injured. These cases may be grouped as follows:

First, fracture of the elbow joint resulting in contractures of the forearm, in which tendon transplantation gave satisfactory results. This was done in two cases.

Second, fracture of the skull with brain injury followed by wrist drop. Complete recovery of the peripheral defect followed repair of the brain.

Third, axillary dislocation of the head of the humerous in two cases, resulting in complete paralysis of the extremity. In both these cases improvement began in about five months, and at the end of a year had recovered satisfactorily, with the exception that there still remained a great deal of pain throughout the extremity.

Fourth, wrist drop following machinery accidents in three cases, in which

the Jones cock-up splint was worn and regeneration of the nerve occurred uniformly after a lapse of about eight months.

Two additional cases of obstetric paralysis have been observed, both of which recovered with the hands placed in normal position.

To me the most important point in the early treatment of these cases is immediate operation to be sure that the nerve is not entirely torn off, and suturing, or other reparative operation should be carried out. The second essential in the treatment is that if the injury has occurred several months previous to observation then care should be taken to hold the extremity in a normal position until regeneration has occurred, so as to avoid troublesome contractures, which always require additional operative procedure and may be avoided by following the above rules.

DR. FREDERICK C. KIDNER, of Detroit, said that there were certain things in nerve surgery which were similar to questions that came up in fractures. In considering nerve injuries men were not willing to give sufficient time to the nerve; the cases were watched for three or for six months, and then it was assumed that recovery would not take place. That was essentially wrong. Experience in England in 1917-1918 in nerve suture, showed that recovery rarely occurred in twelve months, but since leaving England, news had come that about 70 per cent of the cases had recovered in longer periods. It is therefore important to give plenty of time for nerve regeneration before using other methods such as tendon transplantation to overcome disabilities from paralysis. Recovery had been seen of nerves which supply small muscles, that is ulnar, median, posterior tibial, etc. The speaker had not seen recovery where a nerve graft had been done, although such cases had been recorded. The operative side of nerve surgery, he thought, had been unnecessarily condemned. It did not seem necessary to wait long periods of time before operating on nerves. Usually it was safe to operate early by a two-stage method. One could go in within two or three weeks after the skin had closed and find out what the condition was surrounding the nerves. Then one could sew up and watch for sepsis, and if none appeared, finish the operation. That would save the patient six to nine months of waiting. The preliminary operation did not do any harm. Badly damaged nerves often did not need operative interference except removal of bands of scar tissue. Badly crushed and scarred nerves recovered surprisingly well. But several nerves, the earlier suture was done, the better the prognosis. It was almost impossible to tell whether the nerve was severed or not. By waiting to find out, time was wasted. One had better go in and explore. The simpler the operation the better. One sometimes found cases of interposed foreign body, muscle or membrane, actually preventing the union of nerve. This should be removed, and the ends brought together in an easy position with the finest silk suture. The nerve should then be replaced in the best bed it was possible to find, with relaxation of the suture line by manipulation of the joints in the neighborhood. It was better to wait for nerve recovery rather than do tendon transplantation, which gives good result for four or five months, but rarely permanently. In injuries of the musculo-spiral, the hand will adapt itself and become useful in an extraordinary manner. Therefore it is seldom necessary to do complicated and difficult operations. A case was cited of a medical man, a laboratory technician, who had had musculo-spiral paralysis twenty years, with wrist drop, yet he could use the hand almost as well as a normal hand. When there is any doubt about complete division of the nerve, no external examination will positively clear up that doubt. It is therefore unwise to wait in doubtful cases. It is better to operate as soon as active sepsis has ceased. If operation showed any continuity whatever, resection should not be done, but the nerve left alone. Often such nerves recover spontaneously. One man with a suture of the sciatic in 1914, began to recover in 1917, and in 1919 he was still improving. A musculo-spiral which was given up after eight months, but was let alone fortunately, had complete recovery at the end of two years. If there was any fibrous continuity, the nerve would push through. Often at operation one could get a strong electrical response from tissue which

looked like nothing but scar tissue, which proved that there were nerve fibers coming through. Even if there were no electrical reaction it was well to err on the safe side.

Dr. A. H. Cilley, of New York, said that we learn through our own and our friends' failures. Our British friends have been having theirs, and by next year we shall be having ours. One point in doing a nerve suture is to be sure that nerve is sutured to nerve and not to a tendon. In a case near Glasgow, Mr. Kennedy found that the first operator had united the Median nerve to the Palmaris Longus tendon. It is unnecessary to say that the result was not good either as a nerve or tendon suture. In regard to what Col. Starr said about twisting of the nerve fibers; it is possible to get a complete mixup when the nerves are mixed up. One patient operated upon in Glasgow showed conflicting sensation chart, and at operation it was found that the median and ulnar nerves had both been severed, and the proximal end of the ulnar was not united to anything except scar, and the distal portion of the median was the same. The distal ulnar was united to the proximal median and the chart surely was mixed.

In regard to Dr. Cone's point about nerve growth, Kennedy felt that growth took place both ways. Now Dr. Cone seemed to partially agree with this, though at first he thought Dr. Kennedy wrong. What Dr. Danforth said was true about immobilizing the joint above the hand. One knew what happened with hot axles, and a stiff hand was in position of a hot axle. One had to grease the axle.

Dr. R. Hammond of Providence R. I. said that he had visited all the orthopedic centers in the British Isles and the universal feeling was that nothing but end to end suture of healthy nerve fibers would produce growth. Lateral implant was tantamount to failure It was considered that the best work was being done in the clinic of Sir Harold Stiles. The speaker agreed with Dr. Danforth that the voluntary power of the muscle was a more accurate test than electrical reactions.

Dr. J. Torrance Rugh of Philadelphia said that he wished to emphasize two points in Dr. Steindler's paper. Splints with pressure should be applied extremely carefully as the dorsum of the fingers would not stand much pressure. Cases returning from Europe had been seen in which arthrodesis of the shoulder joint had been secured in a position of 40 degrees of abduction. In one man great fatigue and distress was caused by this ankylosis. He had free use of the scapula, but the arm was tired. An angle of 20 degrees was much better.

Dr. Winnett Orr of Lincoln, Nebraska, said he had seen eight cases of ankylosis of the shoulder with loss of the head of the humerous. A fixed abduction position of 40-45 degrees was necessary for a final result. Twenty degrees was not enough.

Dr. E. W. Ryerson, of Chicago, said that it was not yet absolutely established that any method of filling-in gaps between the ends of severed nerves is uniformly successful. Huber, of Michigan, thinks that the sciatic of a young calf can be used. It is of great importance to develop a universal technique, since there are a great many cases which need to have defects bridged over. The method of turning down a flap from the nerve is entirely illogical, and cannot succeed. In some instances it may be wise to adopt the French method, and resect the bones a sufficient distance to allow end-to-end union of the nerve. A hand without the median or the ulnar nerve is seriously disabled. Large gaps in the sciatic may be taken care of by flexing the knee, and to a more limited extent in the region of the elbow, the postural approximation is of much assistance.

Dr. J. Torrance Rugh of Philadelphia said that in the experimental laboratory the anterior crural nerve had been resected and the sciatic transplanted. The anterior crural was re-established and not the sciatic.

DR. A. H. CILLEY of New York said that in ankylosing the shoulder, it should not be fixed at right angles to the body, but in about 60 degrees of abduction with the elbow anterior to the lateral plane of the body so that the humerus would make an angle of about 45 degrees with this plane. This position allows the man to bring his hand to his face, and at the same time does not put undue strain on the Trapezius when the arm is allowed to hang at his side.

DR. H. P. H. GALLOWAY of Winnipeg said he could speak enthusiastically of tendon transplantation in those cases of musculo-spiral paralysis in which there was no hope whatever of restoring nerve power to the extensor muscles.

COL. CLARENCE L. STARR, of Toronto, said that he wished to correct a wrong impression, in regard to bridging of gaps. He had stated that he had never seen a case in his own experience in which the bridge had been successfully done in war surgery. He was not speaking of the literature. No tendon transplant was ever done except in cases of irreparable nerve lesion. It was known at time of operation that it was impossible to recover the nerve. The technic of tndon transplantation had to be properly understood and carried out, or the tendon would slip.

DR. MURRAY S. DANFORTH of Providence, R. I., in closing said that he put Tinel's sign last because of the variations found in it. They did find, however, that making the test by going from a distal point proximally and taking careful measurements certain information could be gained which seemed of value. In some cases where a transplant had been made to fill a gap in a nerve it was found that this sign progressed downward through the transplanted section to the point of suture of the transplant to the distal portion of the nerve. Here it stopped. In these cases it was the intention of Colonel Stiles to explore this point.

In regard to tendon transplantations, the results seen had been satisfactory. For musculo-spiral paralysis the transplantation used was the flexor: carpi radialis into the extensor ossis metacarpi pollicis and the extensor brevis pollicis, the palmaris longus into the extensor longus pollicis, the flexor carpi ulnaris into all the finger extensors, and the pronator radii teres into the extensors carpi radialis longior and brevior. Beginning about one month from the date of operation the patients were put into the curative workshop to train the muscles. During the first weeks of work the wrist was protected by a short cock-up splint.

DR. ARTHUR STEINDLER in closing said that there should be no mistake about which tendons should be transplanted in arthrodesis of the wrist. Wrist drop could be nothing but a hindrance to the function of the hand. The actual muscle power was shown to be decreased 75 per cent by relaxation. Before securing power for the extensors of the fingers one should first take care of the stabilization of the wrist. The flexor carpi ulnaris was used to transfer power to the fingers. Its action co-ordinated with forceful extension movement of the fingers. Arthrodesis of the shoulder is applicable even to younger patients. The triceps is the main stabilizer of the shoulder joint. Even where Deltoid paralysis is present the patient can, by triceps contracture press the humerus firmly into the glenoid cavity and then abduct the arm with the shoulder blade by contraction of the trapezius.

In regard to re-establishment of nerve elements over gaps, I will say that, in experiments of neurotizarion of paralyzed muscle it was shown that it was possible for peripheral nerve, implanted into the muscle, to branch out into it, and the muscle was then capable of being stimulated by the Faradic current. There were also histological changes of the muscle cells; such as regeneration with reappearance of striction, synchronous with the regeneration of the nerve. "I have not been able to find the actual motor end plates, that may have been due to insufficient technic."

TRANSFERENCE OF THE FIBULA AS AN ADJUNCT TO FREE BONE GRAFT IN TIBIAL DEFICIENCY.

BY WILLIS C. CAMPBELL, M. D., MEMPHIS, TENNESSEE

REPORT OF THREE CASES:

When from any cause, gun shot, shell wound, osteomyelitis, congenital or tumor, there is a deficiency in the shaft of the tibia, the leg deviates inward with inward rotation of the lower fragment. This leverage on the upper tibio-fibular joint causes gradual relaxation of the ligaments, resulting finally in luxation with marked prominence of the head of the fibula. The limb can be made straight by passive movement, and a steel brace is essential to weight-bearing, but this may be difficult to adjust on account of the projecting and unstable head of the fibula with the varus tendency of the leg.

In 1905, Huntington severed the fibula on a level with the lower end of the proximal fragment of the tibia, and transplanted the distal fragment of the fibula into the proximal fragment of the tibia. After bony union the same process was repeated at the lower fragment. This proceedure is in reality a two-stage transplantation of the shaft of the fibula, leaving the upper and lower extremities unattached and physiologically inactive.

Stone, in 1907, modified the second stage of the Huntington operation by splitting the shaft of the fibula at the lower fragment of the tibia, leaving one half continuous with the outer malleolus, preventing valgus at the ankle. The other half is attached to the lower fragment of the tibia. In more recent years, with the advent of the bone graft the Huntington and Stone operations have been discontinued, as the free graft is both anatomically and physiologically correct, though not so certain of success. When the free graft, or even the Huntington method does fail—which may be rare—the condition of the limb is not improved and may be rendered more disabled.

In order to make success more certain I have transferred the upper extremity of the fibula as an adjunct to the bone graft; the technique of this proceedure is as follows: An incision in the skin about four inches in length is made over the lateral aspect of the head of the fibula, the deep fascia is incised, then the capsule

of the tibio-fibular joint. All cartilage and fibrous tissue is removed from the head of the fibula, being careful not to injure external popliteal or peroneal nerves. Next, a cavity is made in the inferior and external aspect for the reception of the denuded head of the fibula. Heavy traction will place the head of the fibula within the cavity, provided scar tissue between tibial fragments does not prevent. When such difficulties arise these tough bands are excised or severed, the periosteum of the fibula is sewed to the periosteum of the tibia and the wound closed with cat gut throughout. As the final step, we proceed to do the inlay graft in the usual manner, which needs no description.

This method has been employed in three cases, which give the following history:

CASE 1: White, Male, Age 17. In November, 1917, received a load of squirrel shot (November 6) at close range through the

CASE 1 (A)
Deficiency in tibia from gun shot wound Note dislocation of fibula with loose flail tibio-fibular joint.

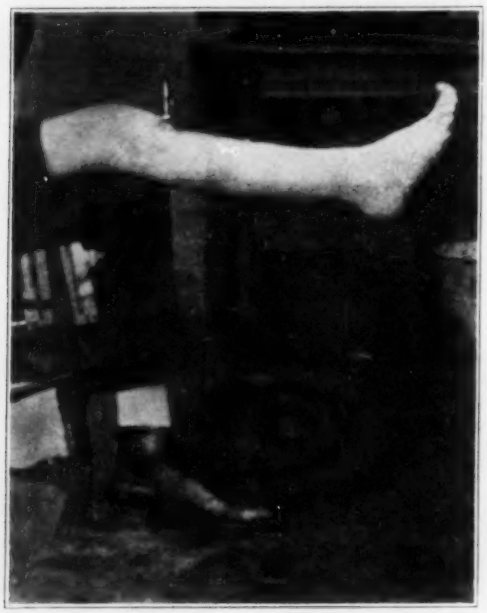
CASE 1 (B)
After transference of fibula and free bone graft in defect, gain in length of about one inch.

upper third of the left libia, tearing away four inches of bone; was first seen August, 1918, when there was 2¼ inches shortening. A sinus persisted, surrounded by pale granulations on the anterior aspect. The skiagram showed a small sequestrum in the upper fragment. The head of the fibula was prominent, subluxated with a loose flail tibio-fibular joint, adding much to the disability; the leg deviated inward with an inward twist of lower fragment. At this time the sequestrum was removed, when healing was uneventful. Oct. 2, 1918, the head of fibula was transferred as above described, and a plaster cast applied. Nov. 20, 1918, cast removed, and much to my surprise the limb was solid, false motion could not be detected, the tibia and fibula above being firmly united. On account of previous infection free graft was delayed until Jan. 15, 1919, which was accomplished from the opposite tibia in the usual routine manner. After this, patient was not seen until May 20, 1919, when on removal of cast bony attachment at both

CASE 1 (C)
Front view four months after operation.

CASE 1 (D)
Side view.

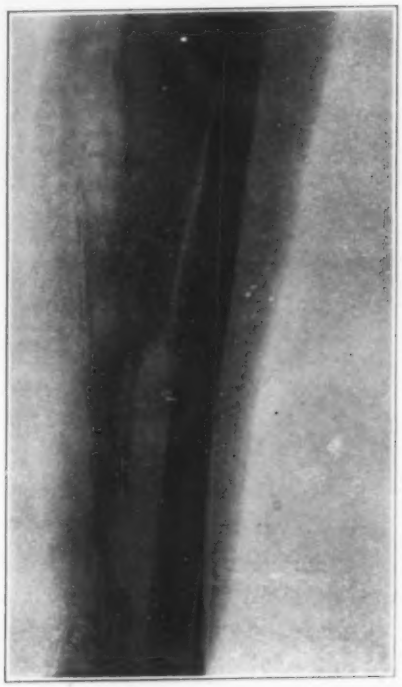
ends of the graft appeared solid. Skiagram shows graft in position and the formation of new bone about the graft. Measurement at this time shows a gain of 1¼ inches in length. A simple steel brace was applied and should remain about four months.



CASE 1 (E)
Showing stability of limb.

CASE 2: White, Male, Age 27. Absence of bone in lower third from osteomyelitis right tibia as shown in illustration. Jan. 3, 1919, operation completed at one sitting; transference of head of fibula and free bone graft from opposite limb to bridge defect. On account of scar tissue considerable dissection was necessary with removal of tough fibrous bands before the bowing and inward twist could be overcome. Following the operation there was sloughing of superficial scar tissue, but no infection. At the end of eight weeks cast was removed, bone appeared solid at all points; skiagram presents a complete bridge of bone. Patient returned to his home with wound practically healed on May 19, 1919.

CASE 2 (A)
Showing dislocation of fibula.



CASE 2 (B)
Showing head of fibula transferred.

CASE 3: White, Female, Age 17. Absence of bone in lower third left tibia from osteomyelitis at the age of 9. On April 20, 1919, same proceedure with the exception of osteotomy of fibula to correct bowing—recovery has been uneventful, all wounds healing by first intention.

CASE 2 (C)
Showing closure of defect after free graft.

The advantages of the procedure are:

1st: It is possible to lengthen the limb 1¼ inches.

2nd: Early transference of head will stabilize limb and prevent shortening.

3rd: At the end of eight weeks we have a stable limb in which no false motion is possible between knee and ankle.

4th: Early stability prevents motion and facilitates the development of the free graft.

5th: New blood supply is added to the tibia through the medium of the fibula, promoting nutrition.

6th: Greater chances of complete success.

There is only one point that I especially desire to emphasize, and that is a two-stage operation should be done in all cases where there is much difficulty in making the limb straight from contraction of dense scar tissue. Most patients will readily submit to the second operation when such marked improvement follows the first.

Sufficient time has not elapsed to consider end results, but the improvement has been so pronounced that a preliminary report of these cases with detailed description of procedure might be worth while at the present time when we are confronted with similar conditions from wounds incurred during the recent conflict.

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Huntington, T. W.; A Case of Bone Transference. Ann. Surg., Philadelphia, 1905. xli 249.

Stone, J. S.; Partial Loss of the Tibia Replaced by Transfer of the Fibula, etc. Ann. Surg., Philadelphia, 1907, xlvi 628.

BRITISH ORTHOPÆDIC ASSOCIATION.

Annual Meeting, November 14th, 1919.

London.

PROGRAMME.

At the rooms of the Medical Society of London,
11 Chandos St., W. 1.

9:30 a. m. Executive proceedings.
Treasurer's Report.
Election of new members.
Election of Officers for 1920 and 1921.

10:00 a. m. President's address.

10:30 a. m. Discussion on "Cineplastic amputations."
Opened by the President.
Discussion continued by: Mr. T. H. Openshaw, Mr. S. Alwyn Smith, Sir J. Lynn Thomas, Mr. F. J. Fitzmaurice-Kelley (by invitation).
Injuries of the crucial ligaments, Mr. W. H. Trethowan.

2:15 p. m. Birth paralysis.
Discussion opened by Mr. H. A. T. Fairbank and Mr. Harry Platt.
Candidates theses.
The operative treatment of spastic paralyses, Mr. A. S. B. Bankart.

The Association Dinner will be held at 7:30 p. m.

On Saturday, Nov. 15th, Hospital demonstrations will be arranged by certain of the London members.

Mr. D. McCrae Aitken will arrange a visit to the Country Hospital for Cripples at Pinner for members and visitors.

Current Orthopaedic Literature

INJURIES TO THE BACK. By James O. Wallace, M. D., Pittsburgh. *Pennsylvania Medical Journal*, Vol. XXII, July, 1919, No. 10.

Injuries to the back may be broadly divided into four classes: (1) Contusions; (2) Sprains; (3) fractures, (a) without cord involvement, (b) with cord involvement; (4) dislocations. Of these conditions I will discuss only two, viz: sprains and fractures without cord involvement occurring in the lower back.

The human body maintains its upright position by means of a system of curves, which are the result of muscular action working against the force of gravity. We have a flexible weight-bearing column attached in unstable equilibrium to the pelvis, through the sacroiliac joints. Nature always fits the part to do the work it is destined to do so we find in studying the muscles of the body that the posterior muscles are much superior to the anterior flexors of the body, the balance being maintained by the posture of the body and the weight of the abdominal and pelvic viscera. In the lumbar region, motion is more extensive on account of the relatively large portion of elastic intervertebral substances, because of the direction of the articulating surfaces, and because the spine is nearer the center of the body. This portion of the spine is the seat of more fractures because we have a freely movable portion passing into a fixed dorsal region and the sacrum below.

The sacroiliac joints situated as they are at the end of the spine on the one hand, and connecting the spine with the pelvis on the other hand are subject to tremendous strain at all times, and it is not surprising that they are commonly subject to sprains, being so intimately connected with one another that to all intents and purposes the symptoms may be discussed together.

The lumbosacral joint consists of the movable fifth lumbar vertebra, working upon a fixed base of the sacrum. The physiological inclination of the pelvis (50 to 60 degrees) places this joint at a great disadvantage, and whenever abnormal posture is maintained, the weight and leverage at this joint subject the ligamentous attachment to tremendous strain. Besides the fifth lumbar vertebra is subject to more anomalies than any other part of the spine.

SACRO-ILIAC JOINTS.

Recent investigation showed that the sacroiliac joint possesses all the histological structures of a true joint. It possesses a certain amount of motion which has been accurately measured in the laboratory, and by the obstetrician in practice, as demonstrated by the Walcher position. The sacroiliac joint has an ear-shaped articulating surface of irregular contour, is almost vertical in position, contains hyaline, cartilage and synovial membrane and its surfaces are bound together by anterior and posterior sacroiliac ligaments which are ligaments of the strongest variety, the posterior being the stronger of the two. In front of the sacroiliac joint lies the lumbosacral cord and sacral plexus,

which gives off branches to the pelvic organs and lower extremities. The sacrum moves either forward or backward through the third sacral segment. It plays an important role in hyperflexion and hyperextension of the trunk upon the pelvis. In considering the functions of the sacroiliac joints it is well to look into the muscles which control this function. The posterior musculature, which has to do with this motion may be divided into (a) an upper and (b) a lower group. The first consists of the erector spinae with its tendinous attachment into the sacrum below; the second, the glutei and hamstrings, which are attached to the ilium and tuberosity of the ischium. The principal function of the lower group, when acting from a fixed point below, is maintaining the balance of the pelvis upon the head of the femur and in further contraction producing hyperextension of the trunk.

Baer classifies sacroiliac strain into two classes: Class A, in which the superior border of the sacrum travels posteriorly, producing the flat back type; Class B, in which the superior border of the sacrum tilts forward, producing the hollow back type.

Symptomatology.

In the traumatic variety we have a history of a mild or severe strain, generally with the body in an awkward position. The pain may be simply an ache, occurring in the lower back, or it may be so severe as to totally incapacitate the patient. The pain is so great at times that any motion causes pain, especially bending to the front or to the side. At times a patient when turning around, will lift his limb with his hands. Pain is usually indicated at the sacroiliac joint, over the center of the sacrum, or at the base of the ribs. It may be referred to the crest of the ilium, to the front of the pelvis and down the thigh even to the calf and the heel, according to the portion of the nerve involved. As a rule the pain in the beginning is not referred down the limb, especially in mild types, but in an acute severe type, the pain may be referred from the very onset down the leg.

There is limitation in forward bending and side bending toward the affected joint. The pain is also complained of at the base of the ribs. This can be explained by the origin and insertion of the erector spinae muscle, pain at origin may be referred to insertion of the muscle. Kernig's sign is positive, producing either pain at the joint or at the insertion of the hamstring at the knee.

Radiographs.

A radiogram usually helps in its negative findings in ruling out disease, although you occasionally get a lipping of the lower limits of the joints which is the result of a hypermobility.

Treatment.

In the traumatic type, treatment depends on the severity of the case. In mild cases an adhesive strapping about 2½ inches wide, applied midway between the crests of the ilium and the trochanters, passing through the third sacral segment, is applied. Whether this dressing acts as an annular ligament to the glutei according to Lovett, or fixes the joint according to most other men, it relieves the symptoms as long as it is taut. In more severe cases in which the simple measures have failed, manipulation is the method par

excellence, because as in any other joint in the body where we have an inflammation, whether it is traumatic or inflammatory, the muscles go into spasm and protect the joint. This manipulation is done with the patient on his back by means of flexion of the extended limb over the abdomen until the foot at times almost touches the chest. This manipulation must be done thoroughly until the muscles are absolutely relaxed. Afterwards the patient is put up in a long plaster spica from the nipple taking in one knee. Care must be used to keep the lumbar spine in its normal curve and at times adhesive strapping applied before the cast is applied is very beneficial. The cast must thoroughly hug the body. Some men use only the body cast, taking it well below the hips. It has been our practice to use a long spica and by this means we get our patients up on their feet in 24 to 36 hours and then get them home. They wear this cast anywhere from 2 to 6 weeks according to the severity of the symptoms and the urgent needs of the patient. After the cast is removed they are given proper support, men a corset with two bars which fit in well to the lumbar region. The corset helps to keep the proper posture and protects the patient from undue strain on the back.

General Considerations.

Mild sprains often repeated produce a chronic condition with adhesions and contractions of the posteroir muscles. The lumbosacral joint is also the seat of sprains, and a dislocation of the posterior inferior facet of the fifth lumbar vertebra is not rare.

Symptoms.

Patients may not stand erect but sometimes after temporary inability, they get up and are able to go home, often they remain at work. Pain, tenderness, muscle soreness, rigidity and a flexed position of the spine are the symptoms in these cases and they are most often treated for contusions and sprains of the back. After getting out of bed if they have been confined, the rigidity of the spine does not disappear. They still complain and in a short while a kyphosis appears and then a roentgen ray is taken and the proper diagnosis made.

Diagnosis.

Most of these cases are hard to differentiate without the aid of the roentgen ray and in these cases none but the most competent man should attempt to ray the back. Where the body of the vertebra is fractured a side view is essential to give you the proper detail.

Treatment.

The immobilization in plaster cast or efficient brace for six months to year will prevent deformity and allow repair to take place except in the most severe cases when more than one vertebral body has been crushed, when the author believes the best results will be obtained by means of a bone transplant into the spinous processes and in these cases a plaster jacket or brace should be worn for at last six months to a year or longer or until the back is strong.—*Leo C. Donnelly, Detroit.*

NOTES ON RE-AMPUTATION... By A. E. Chisholm, F. R. C. R., Edinburgh, Late Captain R. A. M. C. Edin. *The British Medical Journal*, July 19, No. 3055.

SOME REASONS FOR RE-AMPUTATION.

1. Adherent scar with weak or partial healing. If the scar is terminal, and especially if adherent to bone, it is apt to become irritated by pressure of the artificial limb. If lateral and adherent to the bone near its end, there is apt to be trouble from dragging. Such scars may break down. "A large or a small adherent scar is not necessarily an indication for re-amputation. Many cases with an adherent thin scar do well,—better than they would with a better scar and a shorter stump. It is when the stump is conical and has a large terminal scar or ulcer that a re-amputation may become necessary."

2. A chronic granulating surface, especially if terminal and near the end of the bone, is very likely to lead to weak and unsatisfactory healing, with adhesions to the end of the bone, or healing may fail altogether.

3. The presence of sinuses. Huggins says: "No aseptic operation should be performed on a stump until all sinuses have been healed for two or three months." I hesitate to express an opinion contrary to one with so large an experience, but I think that at least in cases with very mild sepsis in the sinuses, much time may be saved and a good result obtained by re-amputation, provided certain precautions are observed.

4. Sequestra. It is usually wiser to re-amputate than to be content with removal of the terminal sequestrum; time will thus be saved as the separation of the sequestrum alone be performed, the resulting end of the bone is likely to be irregular and ill adapted for weight bearing.

THE OPERATION.

1. Avoid a terminal scar.

2. It is rarely wise or necessary to include muscle in the flaps. A good fibrous pad is formed between the skin with its integuments and the sawn end of the bone.

3. Re-amputate clear of the disability for which re-amputation is being performed, and try to make sure that no further operation will be necessary. The object of re-amputation is to get a good, sound, serviceable stump. It is far better to sacrifice a little extra bone, provided it can be spared, than to risk a poor result with the possibility of yet another re-amputation having to be performed some weeks or months later, just because the operation has been too close to or within the danger zone. The flaps should be cut clear of the scar unless there is some real reason in a special case against such a procedure. The scar especially should be avoided if there is slightest suspicion of sepsis.

4. Re-amputation should not be performed in the presence of an active sepsic wound. Healthy granulation is not a contra-indication, but a realy septic granulation surface should be considered a danger signal. The folly of hastening matters in such cases has been proved.

5. If the wound fills up with clot—example, after a reactionary haemorrhage, it is well to open it right up under a general anaesthetic, clear out the clot, re-suture and drain in the usual way. Otherwise there will be great risk of a septic state ensuing.

6. If skin is scanty, and if it is important to preserve the length of the stump with a view to future function and fitting, extension may be applied by means of glue or strapping stretching from the stump to some form of wire splint. This may be in use for days or even weeks prior to operation, and a considerable gain may be achieved.

7. In amputation a short distance below the knee it is well to apply a posterior splint before the patient comes out of the anaesthetic, for there is a great tendency for the knee to assume the flexed attitude of rest, and, if convalescence be delayed, a certain amount of contracture of the hamstrings, often difficult to overcome, may take place.

8. If sepsis appears in a mild form after operation, fomentations or Carrel's treatment may be applied for a few days.

10. In amputations below the knee the anterior edge of the tibia should be bevelled so as to prevent the sharp edge from pressing on the anterior flap. It is important also to divide the fibula about a quarter of an inch higher up than the tibia, otherwise fitting of the artificial limb will be interfered with. According to Huggins it is important to preserve the interosseous membrane so as to prevent outward displacement of the fibula.—*Leo C. Donnelly, Detroit.*

Reports on Cinematic Amputations Based on a Visit to Putti's Military Clinic in Bologna, Italy. By J. A. Gunn. Col., C. A. M. C., and W. E. Gallie, Major, C. A. M. C. *The Canadian Medical Association Journal*, Vol. IX, No. 8.

The cental idea of Putti's work on amputations has been the restoration of the greatest possible amount of the destroyed functions, and the masking of the deformity so effectively that the patient no longer will be an object of pity, nor a victim of his own sensitiveness to appearing in public. These ideas have been put into practice by supplying the patients with artificial limbs which most closely resemble in appearance the normal members, and which are activated by the contraction of those muscles which formerly produced the movements of the amputated limbs. When it is impossible to use such muscles, owing to the position of the amputation, other groups of muscles are employed to supply the necessary motive power, and the patient is subjected to the necessary training to enable him to develop skill in the movements. In the case of amputation of the forearm there is every possibility of employing the principle successfully, as here the muscles which formerly moved the hand and fingers are still present, and if these muscles can be successfully connected with movable parts of the artificial hand, movement and power will be restored which will be under the same neuro-muscular control as under normal conditions.

That the principle is correct both in theory and practice has been most conclusively demonstrated to us. We had an opportunity to see between fifteen and twenty cases in all stages up to three months after operation, upon which cinematicization had been performed. The technique of the operation is exceedingly simple and is exactly as described by Putti and Dalatala in their publication on the subject. The wound is healed in from ten days to two weeks, although a small superficial granulating ulcer sometimes persists for a

week or two at one end of the tube of skin which passes through the loop of tendon. As soon as healing is complete the patient begins to practice contracting the muscles against resistance and within two or three days has developed a power which is remarkable. This power rapidly increases with practice, and within six weeks has reached its maximum. We saw several cases which had a direct traction power on the stirrup which was passed through the tendon loop.

About four weeks after operation the patient is supplied with a temporary artificial hand with which he practices the movements. In this way he develops both power and skill. In the meantime his permanent hand is being made. This consists of a socket and a wooden hand. The socket is exceedingly light and the cumbersome leather corset which usually encircles the arm above the elbow is dispensed with and replaced by a perfectly fitting vulcanite covered metal ring, placed just above the condyles. The wooden hand is similar to those used in various mechanical arms, except that it is very simple. The thumb is stationary and the fingers are joined and movable.

These fingers are connected by means of a strong cord with the rod which rests in the tunnel through the tendon and so respond to contractions of the muscles. A light spring causes the fingers to open moderately when the contraction ceases.

Another important feature of the cinematic treatment employed at Bologna, is the utilization of any rotator power that may be present in the forearm to mobilize the artificial hand. If the amputation is below the insertion of the pronator teres, the patient has strong power of rotation unless the extremities of the bones are fused, or caught in a dense scar. Should such a misfortune have occurred, the first step in the cinematic operation consists of freeing the ends of the bones so that rotary movements will be possible. This rotator power is then utilized to produce rotation of the artificial hand, in addition which is of considerable value, and which is not at present in any of the mechanical hands. The movements are transmitted to the hand by means of a cup which compresses the end of the stump antero-posteriorly, and is connected to the hand by means of a metal rod.

The success of making use of movable stumps or irregularities has led Putti to provide such motors by operative means. We saw one case in which the end of a forearm stump had been converted into two short finger-like processes which acted somewhat like a lobster's claw. By a special mechanical device these processes were utilized to move the fingers of the artificial hand. In other cases the motors are fashioned in the form of pedunculated knobs, around the neck of which are fastened vulcanite covered metal collars which communicate the movements to the fingers. But whilst this method of cinematicization is satisfactory in some cases, we gathered that the operation is difficult, and the result not always certain. The application of the power is not so direct as in the method of tubulization. We are of the opinion that the plan is unlikely to become popular.

By granting the failure of the method to satisfy the high hopes of its chief advocate, the success of the effort has been so great that it is deserving of the highest praise, and of its immediate wide-spreading emulation. It offers

to every man, even the ordinary laborer, the possibility of improving his condition that he is to a great extent relieved of the constant irritation which the loss of an arm causes in ordinary everyday life. Whilst it is not likely to increase the ease with which the farmer, or others who engage in heavy manual labor, can do their daily work, it at least does not lessen their ability to do this work, as the heavy hooks and clamps which are necessary in such occupations can be worked during working hours just as if no cinematic operation had been performed. And even among this class of men, the advantage of being able to write, to act naturally at table, to handle small objects and generally to conduct themselves while off work in a manner which closely resembles the normal, must be admitted to be very great. To the great majority of those who have lost an arm and who will, in the future, be found in shops, in offices, in professions and elsewhere where manual dexterity is not the greatest essential to their earning a living, cinematicization will prove a boon which it is impossible to overestimate. And finally to those who have been so unfortunate as to lose both arms, there is no question that the cinematic treatment will immediately change their lives from absolute dependence to comparative freedom and happiness.—*Leo C. Donnelly, Detroit.*

THE POLICY AND PROGRAM OF THE PHYSICAL RECONSTRUCTION OF DISABLED SOLDIERS OF THE UNITED STATES ARMY. By Frank Billings, M. D., Chicago, Ill. *The New York State Medical Journal*, Vol. 19, August, 1919, No. 8.

Physical reconstruction, as it is now defined, is recognized as the continued management and treatment of the sick and wounded disabled soldiers carried out to the fullest degree of maximum physical and functional restoration consistent with the nature of the disability, by the employment of all known measures of modern medical management, including physio-therapy, manual and metal work, recreational play and military drill.

The division of physical reconstruction in the office of the Surgeon General was organized with a director responsible for the administration of the work. Subsections were organized on education, physio-therapy, the training and education of the blind, the training and education of the disabled soldier who suffers from deafness or from speach defects, and after the armistice a subsection on convalescent centers. A director was appointed and made responsible for the activities of each subsection.

In the application of curative work in the wards for bed and chair patients, women were secured as civilian employees, designated as Reconstruction Aides in Occupational Therapy. Only those women were accepted for this service who were fundamentally qualified because of previous education or experience as teachers in high schools, colleges and universities, and who were willing to take short courses of intensive training in the arts and crafts. Some of the aides were accepted because of their experience in civil life as medical social welfare workers.

Civilian employees who were accepted in this service were fundamentally qualified, because of intensive training in schools and hospitals, to give massage, local baths, thermo-therapy, and other forms of physical treatment.

Recreation in the form of exercise in gymnasia and in outdoor games was secured tthrough the American Red Cross, co-operating with the Y. M. C. A., the Knights of Columbus, the Jewish Welfare Board and in the convalescent centers with the commission on training camp activities of the War Department.

Facilities for the application of curative work, physio-therapy, and recreation in each of the military hospitals functioning in physical reconstruction was secured by the construction of new buildings, or by the alteration of existing buildings, and gardens and lands were secured by purchase or lease for the training of men in outdoor pursuits for playground purposes.

The equipment for work shops and for physio-therapy was secured as rapidly as the conditions due to the governmental war program permitted. The American Library Association co-operated in furnishing desirable text books and light and heavy literature for the use of the disabled men. The division of physical reconstruction, co-operating with the Federal Board of Vocational Education, prepared courses of study embracing fifty different educational subjects and trades as guides for the disabled soldiers and for the teachers in the application of the curative work shop schedule. The application of occupational therapy and of physio-therapy in the treatment of sick and wounded disabled soldiers has proved of the greatest value in the earlier and more certain cure of patients.

At the U. S. General Hospital No. 11, Cape May, an efficient school for the disabled soldiers with deafness and defects of speech successfully teaches lip reading and correction of speech defects. The patients receive prevocational or vocational training.

At General Hospital No. 7, Roland Park, Baltimore, there was established a school for blind or near blind soldiers, sailors and marines. The blinded man is taught how to dress, feed himself and get about as an independent individual, and at the same time instruction is given in Braille, typewriting and coincident training in occupations suitable for the blind.

The disabled tuberculous soldiers are treated in military sanitaria. Curative work has been established in each one of these institutions. Curative work for the tuberculous soldier is modified to meet the varying clinical conditions of that disease and is applied under constant watchful medical supervision. Curative work has proved of the greatest value to the tuberculosis patient in the prevention of hospitalization, and is especially valuable in the treatment of the convalescent in the production of the final hardening process which is so valuable in the prevention of relapse when the stage of inactivity of the disease has been secured.

After active warfare ceased, disabled soldiers from the A. E. F. were returned to the United States in large numbers. It became necessary to amplify the number of hospitals with facilities for physical reconstruction in this country.

The problem of supplying the necessary personnel, available room for shops, adequate school rooms, space for physio-therapy, gymnasia and required equipment was satisfactorily met.

Following the cessation of hostilities and the more rapid return of disabled soldiers from the A. E. F. to the United States, convalescent centers were established by the General Staff in nineteen of the training camps. To these centers were sent convalescent detachmentts from overseas and convalescents from general and base hospitals on a duty status. The final hardening process before discharge of the soldiers in the convalescent centers was brought about by the application of curative work, military drill, setting up exercises, and recreational play.—*Leo C. Donnelly, Detroit.*

ON FOCAL INFECTION AS A CAUSE OF PAINFUL HEEL. By Sigmund Epstein, M. D., New York. *Medical Record*, Vol. 96, No. 5, Whole No. 2543, New, York, August 2, 1919.

The tonsil is a clearing station for mouth infections, and it is manifest that the tonsillar attacks are often due to dental troubles; hence some arthritides are not cured until appropriate extraction is carried out, or until pyorrheal pockets are cleared up.

The dental cases can be exceedingly acute and destructive. The more chronic cases are seen in middle age or elderly patients, and osseous changes can be demonstrated around the joints. Total ankylosis is not common.

I will offer a few impressions of my study of many cases seen in private and clinical practice:

1. I believe that the results of extraction of teeth are more brilliant than those of root-amputation.

2. Ofter the beneficial results of removal of septic bridges, and of forgotten or buried septic roots can be felt within a day, after the eradication.

3. Do not expect this to happen where there are marked bony changes around the margins of the joints, such as the X-ray shows in the form of osteophytes of greater or lesser size.

4. The results of extraction of septic dental foci are more favorable in younger patients, especially where the symptoms are polyarticular or muscular.

5. Physicians should be able to recognize pyorrhea, neglected or infected teeth, teeth of dark appearance, gold and porcelain crowns. Sinuses, especially small ones, should excite suspicion and should be followed up roentgenographically. In this day and age of literature on focal infections and their diligent tracing, it is to be wondered that cases still escape the vigilance of the most careful medical attendants. Especially when the patient is a practicing physician is the loss of time as well as the extension of the disease process more lamentable.

Arthritides and osteoarthritides are common from dental infection, but distinct calcaneal periostitis has not been, in my observation, so common.—*Leo C. Donnelly, Detroit.*

BONE REGENERATION AND THE CONDITIONS OF SUCCESS IN BONE GRAFT. Dupuy De Frenelle. *Press Medicale*, June 23, 1919.

Bony spiculae at the ends of the fragments of fracture diaphyses, being denuded of the periosteum by the traumatism, die off, even if recovered by periosteum. Osteoblasts travel from the fragmental ends and the penetration takes place from all layers of the bone. Of these, however, the medullary canal is of the greatest importance.

The bony bridges uniting the fragments show a tendency to disappear in the measure in which new bone formation from the osteoblasts takes place. Three factors are to be considered in the preparation of the fragments: The opening of the medullary canal, the refreshing of the ends and the preparation of the graft beds.

The graft should be cut of spongious and persistant bone tissue. It should be proportionate in length and thickness to its requirements. The larger its medullary surface, the better its bone production. In regard to regeneration it does not make any difference, whether or not it is covered with periosteum. Exact alinement of the graft and the bone ends is indispensable.—*A. Steindler, Iowa City, Ia.*

TREATMENT OF JOINT, BONE, NERVE AND MUSCLE INJURIES BY MECHANICAL MEANS. By Joseph C. Scal, M. D., New York. *New York Medical Journal*, Vol. CX, Whole No. 2122, No. 5.

In sprains the sooner mechanical treatment is instituted the more rapidly a normal condition can be obtained. After resting the injured part and applying cold applications for 24 hours, active and passive treatment, consisting of a exercise and massage, should be begun. No pain accompanies proper movement; the presence of pain is an indication motion should be stopped temporarily. This treatment can do no harm as there is no danger in exercising and using a sprained limb, in fact it tends to restore function to muscles and joints, reduce swelling and edema, promote absorption, and prevent adhesions, no matter how slight the injury may have been.

In cases where the relief of swelling is necessary during the first 24 hours a bandage applied firmly and evenly over a number of layers of absorbent cotton will obtain the desired result by preventing further extravasation and promoting absorption in from 6 to 8 hours. This treatment should be used only in the first 24 hours after the injury. In cases where the confidence of the patient cannot be obtained so as to make him co-operate in exercising and using his limb, strapping is the next best thing.

Fractures—The ideal treatment of fractures consists of reduction and the X-ray; prevention of recurrence by splintage; relief of pain and elimination of edema by early baking and gentle massage, and the prevention of adhesions and muscular wastings by graduated contractions. Early bakings, light massage and passive movements will shorten the period of disability and length of treatment and prevent after effects, provided good union and good apposition exist; will prevent adhesions and stiffness in joints; reduce atrophy of muscles to a minimum and prevent excessive callus. When a fracture is near a joint and

kept immobilized in splints until union is firm, the joint will become stiff and muscular atrophy will result. In these cases it is advisable to remove the splints as early as possible and institute baking, massage, and the various mechanical movements.

Nerve injuries.—Especially in peripheral nerve injuries weakness and muscular wasting inevitably result and these are followed by paralysis and contractures. When nerves are cut the joints should be kept free and the nutrition of the muscles around them maintained so that the joint will be able to tunctionate when the nerve recovers. If a severed nerve is sutured, which should always be done if possible, it must be held in a position which will produce as little tension as possible on the nerve or paralysed muscle until function is restored.

Treatment by heat.—An affected limb should be kept warm and protected from cold. Heat also makes treatment by massage and electricity more effective and should be applied before and after such treatment when possible.

Treatment by massage.—To be effective massage must be gentle at the beginning, all movements must be painless and should be applied daily from the early stage.

Treatment by exercise.—This is used for re-educating and redeveloping wasted muscles and consists of active exercise against resistance. For a shoulder joint with limited movement the so-called "wall climbing" exercise is advised. This consists in the patient standing with his face against a wall or door, and putting the hand to the affected side as far up as he can, endeavoring to place the finger tips on the top. When he reaches the top he fixes the hand with the other well hand and bending knees slightly uses his body weight to exert a pull on the joint.

Treatment by graduated contractions.—This is ideal routine for muscular wasting and muscular insufficiency, and no matter how wasted a muscle is, provided the nerve supply is undisturbed, a contraction can be obtained. It should be given daily from 10 to 15 minutes together with gentle massage. It is indicated principally in sprained muscles. The method of application is to place the limb at absolute rest, and apply the faradic current, the degree of contraction being controlled by the manipulator, and a group of muscles is stimulated while in absolute relaxation.

In conclusion I would say that a stiff and crippled part can be restored to functional utility only by getting rid of adhesions, resorting mobility and rebuilding the muscular tissue which has been permitted to waste and atrophy. With the early application of the forms of treatment outlined here we will see fewer stiff joints and wasted members than we have seen in the past.—*Leo C. Donnelly, Detroit.*

Bone Regeneration Following Osteomyelitis. By Stewart L. McCurdy, M. D., F. A. C. S., Pittsburg. *The Pennsylvania Medical Journal*, Vol. XXII, February, 1919.

This article is well illustrated and does not entirely follow the "beaten path." He states that the technic of the removal of a sequestrum and rearranging of the involucrum is very important. It consists in chiseling away

sufficient of the involucrum where it is thinnest to remove the sequestrum, and then breaking down the involucrum in such a way as to push it down into the cavity left by the removal of the sequestrum, completely filling the space. The new bone fragments act as bone clips do elsewhere. Such a wound should be poured full of 3% tincture of iodin after removing the sequestrum and before breaking down the involucrum. The bone, if possible should be reduced in size so as to permit the closure of the skin throughout. No packing should be used; it destroys blood clot organization and prevents repair. No wound is going to close until it is ready, and packing may prevent closure.

The method of repair is about as follows: The blood clot which fills in the cavity serves as a trellis work into which the leucocytes begin to pour from the healthy blood vessels immediately after all operations and injuries. In the course of a few days, the blood clot has been entirely displaced by the scavenger leucocytes and teh cells thrown out along the margin of the wound for the purpose of reconstruction and repair. The reparative cells eventually take the place of the leucocytes and become thoroughly organized, and the cavities are thus filled with new formation.

The author's conclusions are:

1. Bone regeneration is from the osteoblasts only and cannot come from the periosteum or other tissue.

2. Sequestrum, though very loose, should never be removed until regeneration of new bone has advanced far enough to maintain the normal position and perform the normal function of destroyed bone.

3. Three and one half percent. tincture of iodin is the antiseptic par excellence in all cases of bone infection. It should only be used once a week.

4. Packing in and around bones that are dead, destroying the healthy granulations, also destroying the bone's normal function of producing new bone throughout its circumference, should not be used. I am not sure who introduced this pernicious practice, but I believe it has done more harm to bone surgery than any other one thing that has happened in centuries.

5. The serum of repair is not pus, since it is not phagocytosis and does not require strong wet dressings, as practiced by so many surgeons as a routine. Normal salt is to be preferred when the patient is without temperature.—*Leo C. Donnelly, Detroit.*

TRANSPLANTATION OF BONE FOR DEFECTS OF THE HEAD AND NECK OF THE FEMUR. By Chas. Davison, A. M., M. D., F. A. C. S. *Surg., Gy., and Obstet.*, Vol XXIX, August, 1919, No. 2.

In a very well illustrated article the author states that autoplastic transplantation of bone is of value in three types of defects of the head and neck of the femur, but in all cases the patient must be vigorous enough to withstand the operation, and young enough as an economic possibility, to warrant the attending discomforts and dangers of the procedure and the expense of time and effort required for a successful issue.

1. Recent fractures of the neck of the femur without impaction may be repaired by grafting a segement of fibula across the line of fracture. To

obtain ideal results the repair should be performed early before the vitality of the capital fragment has been disturbed by lessening of its blood supply. Under favorable conditions the union of the fracture resembles healing of wounds by primary intention and without doubt the capital fragment retains its integrity and persists as a vital portion of the femur.

2. Ununited fracture of the neck of the femur with diminished vitality of the capital fragments may be repaired by transplanting a segment of fibula across the nonunion. Under favorable conditions the transplant grafts to the lower fragment in a manner similar to that in recent fractures. In the capital fragment the process is different. It simulates the healing of wounds by granulation. There is a stimulation of osteogenesis by the transplant with projection of new bone cells into the devitalized fragment which acts only as frame-work for the deposition of new bone. The old bone is gradually absorbed as it is replaced by new bone. Under the stimulus of the transplant, new bone is deposited in and around the area of the nonunion, until the old fracture is obliterated. Later both the transplant and the new bone are absorbed and modified until there is compensation between elasticity, strength and function.

3. The head of the femur, destroyed by injury or disease, may be replaced and fair function re-established by transplantation of the head and upper part of the fibula into the upper end of the shaft of the femur in such a manner that the articular surface of the head of the fibula will articulate with the acetabulum. Under favorable conditions the transplant will graft to the shaft of the femur. The part of the transplant which replaces the head and neck of the femur, will hypertrophy until its size and strength are sufficient to meet the functional demands made upon the hip-joint in walking.—*Leo C. Donnelly, Detroit.*

THE WORK OF THE FEDERAL BOARD FOR VOCATIONAL EDUCATION. By Mr. H. L. Brunson, Superintendent of Placement, Division of Rehabilitation, Federal Board for Vocational Education, Washington, D. C. *Pennsylvania Medical Journal*, Vol. XXII, May, 1919.

The first step in this program of rehabilitation is to get in touch with the disabled man. The plan is to get in touch with him at the hospital, just as soon as possible in view of his physical condition, and advise with him concerning his future; to find out what his experience has been, what education he has received and guide him into an occupation in which the equipment which has been spared to him can best be used. Choosing the occupation is a big task, as the patient usually has a very definite idea about what he should do, and in many cases it is difficult to convince him that his judgment is wrong. In most cases it is necessary to place the man in some position and try him out on the job to determine whether he can carry on in that line of work. Development will prove whether he can or not. If unable to make good, then he is a subject for training. Reference is made to this point to show the character of the problem confronting the federal board.

It is planned by the federal board to provide training for these men in every occupation known to be suitable. This phase of the work cannot be carried on

to any great extent in schools. It will be carried on in factories, mills, shops and offices, and everywhere that men can be trained, or tried out in employment to prove whether they can, with their remaining equipment, do the things that they must be able to do in order to carry on the job. This requires the assistance of the employer, and the sympathy of fellow workmen. In fact the aid of every factor in society is needed to carry out the work successfully.

After a man has been trained, or placed in employment as a test of whether he can carry on in that particular line, he is to be followed up. He will be interviewed frequently. His employer or the person directing his training will be required to provide the federal board with information at intervals, so the board may know how the man is getting on. If he requires shifting or direction in some other line, the officer of the board will know of it and will change his training or secure for him other employment.—*Leo C. Donnelly, Detroit*.....

RETURNING THE DISABLED TO ECONOMIC INDEPENDENCE. By Mr. Douglas M. McMurtie, Director, Red Cross Institute for Crippled and Disabled Men President, Federation of Associations for Cripples, New York. *The Pennsylvania Medical Journal*, Vol. XXII, May, 1919.

In one way compensation legislation has failed to meet the needs of the disabled. In the light of our present knowledge and experience, compensation practice, taken alone, has fallen short of success. The legislation has not been, in its results, in any way constructive. It extends to the man a meagre stipend on which he may or may not be able to live, and leaves him to exist in idleness. Present provisions of law are almost an incentive to idleness in that a man's compensation award is prejudiced the moment his economic condition begins to improve.

We have had enough experience with the disabled soldier to realize that the only plan worth while is to restore him to economic independence, to place him beyond need of monetary aid or compensation and pension laws,—and thus solve his problem permanently and satisfactorily.

It is not a measure of philanthropy, but one of clear, cold, business judgment. For industrial rehabilitation, no one needs to pay the cost. There are a great many ways by which insurance companies and state funds can save themselves money. One is by provision of unlimited and high grade medical attention.

The chief expense of training men is not putting them into classes and having them taught; it is maintaining them while in training. No matter how excellent your mechanism of re-education may be, if you go to a man earning $6.00 a week and say, "This is too low; you could be earning at least $20.00 weekly; come to our school and we will train you for a job," it is out of the question for him to undertake training because, in the meantime, his family would starve. So we face the necessity of maintainance. During compensation a man would have some income on which to live but after that period has expired maintainance becomes a serious problem, and we have to supply money to support the man while undergoing training.

A plan of paying a minimum award for personal inconvenience involved as result of a given disability, not to be reduced under any circumstances is worthy of serious consideration. There would then be further compensatory advantage in the provision of thorough re-education, and in case a man made an earnest attempt at rehabilitation and failed, there would be further award in the discretion of the state compensation authority making the total benefit at least as great as, and preferably greater than the disability payments under present practice.

There is considerable discussion of the extra accident hazard in the case of men already disabled. There may be such added hazard in the employment of disabled persons placed at random, but I believe that such men when wisely placed involve no greater risk than the able-bodied. A man who has once been injured will take some care not to have a second accident.

The other influence with which we have to deal is the general attitude of the employer toward disability. He has always regarded the disabled man as a hopeless case and is not willing to believe that such a man can do anything useful. The first necessity in operating an employment bureau for disabled people is to get at the employer and convice him that men who are disqualified for some jobs are not shut out from others, and make him willing to take the cripple into service. One of the most useful mechanisms to bring employers to recognize the possibilities of crippled workers is known as the "industrial survey to discover openings in industry for the physically handicapped."—*Leo C. Donnelly, Detroit.*

THREE AMPUTATIONS OF THE FOOT DESIGNED TO RETAIN THE CALCANEAL TREAD. By C. E. Corlette, M. D., Ch. M. (Syd), D. P. H. (Camb), Sydney, Australia. Surgeon, Sydney Hospital, New South Wales. *Surg. Gyn. and Obstetrics*, Vol. XXIX, August, 1919, No. 2.

In a well illustrated 20-page article the author describes three new amputations of the foot at the mid tarsal joint. The technic should be closely followed as his work has been amply proven with work on the cadaver.

This article contains a volume of carefully worked out details which makes it difficult to abstract. The original article is well worth studying.

1. **Flaps.** Preserve all viable material, or at least an ample surplus, and trim down later. The upper flap is cut by an incision starting at a point midway between the tip of the lateral malleolus and the tuberosity of the fifth metatarsal bone and coming across the dorsum of the foot to a point a little behind the prominence of the navicular bone on the medial side of the foot. As the cut crosses the dorsum of the foot it curves forward somewhat, crossing the bases of metatarsal bones. The plantar flap extends a little farther forward on the sole than the upper flap does on the dorsum. But it is better to have some surplus to cut down than too little to work with.

2. Disarticulate at the mediotarsal joint.

3. With the osteotome remove the lower third of head of talus, shave the plane surface underneath the remainder so as to give the plane a certain

amount of slant upwards as the cut runs backwards. The interosseous ligament presents itself.

4. With the osteotome cut through the base of the sustentaculum tali flush with the side of the calcaneus, sever its ligamentous attachments and remove it.

5. With the osteotome cut the greater process of the calcaneus at cuboid articulation horizontally across, pointing upward and backward to the groove just in front of the convex articular facet on the upper part of the calcaneus

6. Loosen the calcaneus from all soft parts except on the plantar surface and its edges.

7. Finish paring, by thin shaving, the under surface of the talus, until the whole under aspect of bone presents a flat surface with an upward backward slant.

8. With an osteotome shave off superior surface of calcaneus upward and backward to a point on the saddle-shaped superior surface behind the posterior limit on the convex articular facet.

9. Push the calcaneus well forward placing cut surfaces of both bones in close opposition.

10. Bore a hole horizontally from side to side through the neck of the talus, behind the head and fairly high up. Bore a similar hole through calcaneus a little behind hole in talus.

11. Cut and trim the flaps to the exact shape and size desired. In doing this leave the anterior tendons long, so that they can be sutured to the base of the lower flap.

12. Remove the tourniquet and attend to haemostasis, using plenty of hot water.

13. Pass wire or kangaroo tendon through holes and tie bones together.

14. Appropriately trim down projecting portions of calcaneus.

15. Suture the anterior tendons to the lower flap in front of the calcaneus, as low down as possible.

16. Close the wound, putting a short and sufficiently wide tube at each side to provide for oozing. These tubes should be removed within 36 hours.

OPERATION 3.

1. Flaps similar but shorter than No. 1, disarticulate at mediotarsal joint.

2. Cut off sustentaculum as in No. 1.

3. Enucleate talus.

4. With osteotome remove a slice of the distal extremity of the tibia and lateral malleolus at same level as that prescribed for Syme's operation.

5. With osteotome section calaneus beginning at base of convex articular facet, slope upward and backward to apex of smooth surface above insertion of tendo achilles. The surplus lengths of all tendons should be removed well back.

6. Push calcaneal remnant well forward 2½ or 3 cm. ahead of tibia, bringing natural tread in line of pressure.

7. Bore transverse holes through tibia and calcaneus and wire them together.

OPERATION 2.

1, 2, and 3. Incisions, flap material, removal of sustentaculum and talus same as in No. 3.

4. Soft parts separated from either side of calcaneus. Clean lower anterior extremity of tibia and surface and borders of malleoli.

5. Remove prominent upper and anterior part of greater process of calcaneus.

6. Shave upper surface of calcaneus until a broad surface with an upward and backward slant is formed. Excellent results can be obtained without going back to posterior surface. In under surface of tibia cut a trench, sparing malleoli, from before backward to receive calcaneus.

8. Trim fibular malleolus to allow fit.

9. Drill holes through malleoli.

10. Drill transverse hole through calcaneus.

11. Remove tourniquet, wire calcaneus into place.

12. Smooth off anterior surface of calcaneus.

13. Close wound.—*Leo C. Donnelly, Detroit.*

THE CRIPPLES OF A COMMUNITY. A SURVEY OF THE DISABLED CHILDREN AND ADULTS IN CLEVELAND, OHIO, AND A STUDY OF THEIR NEEDS. By Douglas C. McMurtrie, New York. Director, Red Cross Institute for Crippled and Disabled Men; President, Federation of Associations for Cripples. *Medical Record*, August 23, 1919.

How many cripples are there in any given community? To what extent have they made their own readjustments and placed themselves beyond the necessity of assistance? What are the needs of others who have encountered difficulties, educational or economic? An attempt to answer these questions for the city of Cleveland, Ohio, was made in a survey conducted during 1916 by the Welfare Federation of Cleveland. The findings of the study have just been made public.

The "Cleveland Cripple Survey," as it is known, had its genesis in the interest of public spirited citizens of that community in the cause of the crippled child, and the desire to have reliable and scientific guidance in the effort to make further provision for cases of juvenile disability. The survey is more than a census, for each case was studied to ascertain what light it could throw on the needs of the cripple in general. It was found that the cripples themselves might be considered the real authorities on the problem of physical handicap. As the report says, "A man with double club hands and double club feet, a meagre education and no medical treatment in his life, but who supports himself and others for nineteen years without aid, can, if he be a thoughtful person, speak with authority of handicaps.

The definition on which the survey work was based is set forth in the statement of purpose made by the committee: "To discover the economic and educational needs, capacities and possibilities of children and adults in Cleveland who are handicapped because they lack the normal use of the skeleton or skeletal muscles."

There were found in Cleveland 4,186 cripples of all ages, which calculated in ratio to total population indicates six cripples to every thousand inhabitants. The age distribution showed 22 per cent. under 15 years of age, 61 per cent between the ages of 15 and 60, and 17 per cent. 60 years old and over.

In sex distribution 63 per cent. were male and 37 per cent. female. The discrepancy is due to the greater liability of males to accidents. Within the working age limits there was even more marked disproportion. Among those between 15 and 60 there were 68 per cent. male and 32 per cent. female. Classified as to color there were 97 per cent. white against 3 per cent. colored. Of the 4,076 white cripples 66 per cent. were native born and 34 per cent. foreign born.

One of the first requirements in determination of the needs of cripples is a knowledge of the age periods in which crippling most frequently occurs. That the problem is largely one of the childhood period is shown conclusively. The community is justified in concentrating on the surgical treatment and the provision of special educational advantages for crippled children. It is an almost startling fact that 49 per cent. of the total cases covered by the survey became cripples before the age of 15, while 34 per cent. developed their handicap before the age of 5.

The next finding of interest showed that 59 per cent. of the cripples over 15 years of age were employed.

The authors suggest that the work for crippled children should be met as part of a general, liberal program for prevocational education.

The problem of the crippled adult is a problem of working life. Legislation should be passed adjusting for employer and employee alike all matters of compensation and insurance that now stand in the way of re-employment.

The knowledge gained during the war along the lines of surgery, prosthesis, occupational therapy and vocational education should be widely spread and applied to all cripples, whenever possible.

Provision for industrial training for the competent among the handicapped should form a part of an adequate vocational training for all citizens, under federal or state auspices.

There should be special provision for placement of those who cannot place themselves and for the special employment in home industry of semi-invalid cripples taking some small part in active life.

Propaganda should overcome the prejudice of the public against cripples. "An ambitious mechanic, looking for a real job, finds himself classified with the shoe-string peddler, just because he has the same disability. A man with crutches hears people 'speaking up loud' to him, exactly as they would to a person with smoked glasses or to foreigners whose language they do not understand. These apparently trivial things are in reality signs of general inability to see the man behind the handicap, and are the very things that make

the cripple think he is helpless. They contribute to idleness among cripples and help create the group of sensitive recluses who only wish to come out after dark and to discourage the workman who keeps his crippled hand well hidden in his pocket."

Most important of all, methods of prevention should be devised, in regard to the accidents of industry, to those of everyday life, and to the ravages of such diseases as infantile paralysis and the tuberculosis of early life. Scientific study along such lines can and must reduce greatly the proportion of accidents in future years.—*Leo. C. Donnelly, Detroit.*

CONGENITAL RADIO-ULNAR SYNOSTOSIS. By James Warren Sever, M. D., Boston, From the Orthopaedic Department, Children's Hospital. *Surg., Gyn. and Obstet.*, Vol. XXIX, August, 1919, No. 2.

The condition is apparently an hereditary one, prone to occur in succeeding generations without any known cause from an embryological point of view. Feidt, quoting Lewis, states that "at the sixth week of foetal life the distal ends of the forearm bones were distinct and separated from each other, and that the perichondrium of the proximal end of the radius was continuous with that of the adjoining surface of the ulna." Lambertz' law relating to these cases is as follows:

"In the extremities, the ends which show a more elaborate development as regards shape have a less degree of growth, hence, as the radius does not develop in form it seems to increase in length." This embryological condition may therefore be carried over into full foetal development in some cases, especially those with an atavistic tendency."

Clinically the cases present a bony fusion of the upper ends of the radius and ulna not involving the elbow joint and resulting in a lack of ability to supinate. There is some ability to turn the palm of the hand up but only by means of outwardly rotating the humerus. No power of true supination exists. The bony fusion may cover an area 3.5 to 6 centimeters; in the case reported the distance was 3.5 centimeters. The radius is generally bowed as well as thickened.

Operation consists of a 1½ inch incision on the outer side of the forearm about 2 inches below the elbow-joint. One-half inch of the radius is resected. No attempt is made to divide the interosseous membrane or head of the radius. The hand and arm are put up in plaster in the position of full supination and held for six weeks.

The simplicity of this operation as contrasted with the more difficult procedures which involve the section of the head of the radius with the attempt to establish a new joint and which have led to poor results, is in its favor.

The child has a very rigid course of after treatment in muscle training, exercise and massage, all leading to the development of the forearm muscles, especially the supinators which are markedly atrophied from disuse.—*Leo C. Donnelly, Detroit.*

PROGRESS OF ORTHOPAEDIC SURGERY. By C. Hermann Bucholz, M. D., Robert Soutter, M. D., Lt.-Col. Robert B. Osgood, H. C. Low, M. D., Maj. Murray S. Danforth, Boston. BONE AND JOINT SURGERY, *Boston Medical and Surgical Journal*, Vol. CLXXXXI, No. 7.

ARTHROPLASTY.

Baer has had the chance to reopen four of the joints where arthroplasty with animal membrane had been done. In each case he found that the joint space persisted and the lining of the bones was perfectly smooth. The microscopic examination showed that the membrane is transformed into a fibrous tissue which covers the bone and that a joint-like space is formed with fibrous walls, similar to the walls of a cavity encysting a foreign body.

The advantages of the membrane are: (1) the joint will retain as near its normal shape and size as possible; (2) the simplicity of the operation; (3) the stability of the joint; (4) less chance of infection because of the lessened handling; (5) less painful after-treatment, because movements are not begun before three weeks; (6) a normal joint is the ultimate result; no foreign substance is left because the membrane is absorbed within 60 to 100 days.

The membrane must be (1) thin and flexible; (2) tenacious to withstand disintegration for 60 to 100 days; (3) durable; (4) absolutely sterile. The membrane is made in the following way: The pig's bladders, carefully selected, are thoroughly cleansed and disinfected and the submucosa obtained. They are then soaked in a medium hard potassium chromate solution for 24 hours, after which they are cut into the proper size, stretched on boards and exposed to the sunlight for 3 days, until the color corresponds to the reduction of the chromic salt. After being freed from all their soluble chromic salts they are thoroughly dried, and are then inserted into sterile glass tubes containing chloroform. At the time of the operation these tubes are boiled for 5 minutes. The tube is then broken and the membrane, placed in normal salt solution for 10 minutes before using.

Allison and Brooks have made a careful and comprehensive study of the history of arthoplasty and have contributed to our knowledge by valuable experiments. They agree with Baer in considering animal membrane the most promising material for interposition, but emphasize that the substance used must have the least possible irritating properties. They have prepared a silver impregnated fascia in the following way: Living fascia is immersed in a solution of silver nitrate until it is hardened, and then the silver nitrate absorbed by the fasca is reduced to metallic silver. This gives a sterile, pliable, thin, non-irritating membrane. The reasons for the addition of the silver are: (1) metallic silver has definite inhibitory powers both for organisms and tissues; the method of fixation is such that the membrane is always perfectly sterile; (3) the fixative, which is of necessity an irritating chemical, is entirely destroyed. The fascia may be taken from the patient by a preliminary operation. In doing arthoplasty on the knee joint the authors have previously used the horseshoe incision with temporary resection of the tibial tubercle; but recently they have given up this method of approach in favor of the anterior longitudinal incision, because they emphasize the necessity of early active and passive mo-

tion, which would not be safe before the time the tibial tubercle is perfectly united.

Bone Grafts.

Keith discusses the history of bone grafting and sums up the subject as follows:

Among the conditions which determine the successful grafting of bones or bone fragments, we must place first asepsis. Grafts answer best which are taken from the patient's own body; the closer the genetic relationship of the graft-host, the better is the graft likely to answer. The graft-host should be young, and those grafts do best which contain all three elements of bone—bone, periosteum, and medullary tissues. The graft-bed must be free from blood-clot. Washing in normal saline solution damages the vitality of a graft. A graft must be placed so that the contact is effected by adjacent fragments; the contact must be firm and so designed that the graft becomes early subject to the mechanical stresses and strains of the part.

Numerous experiments as well as a sufficient amount of clinical experience have convinced Gallie that boiled bone is an excellent substitute for the autogenous graft. The great advantage lies in the chance to model the graft beforehand and save time during the operation. In this way plates and screws have been made for fractures, long screws for fractures of the neck of the femur, grafts especially modelled for spinal operations, etc. Gallie points out the difference which exists between bone grafting in fractures and in Pott's disease in so far as in the femur the contact is uninterrupted and in the latter not. But by examining operated cases 7 months and 2 years after the first operation, he has found that even those parts of the graft which have not been in contact with bone become organized and at the end represented living bone. The observation that cancellous bone will be vascularized and permeated by living osteoblasts much more quickly than the dense bone of the cortex holds true also for boiled bone. Hence for plastic operations the material should be as porous as the required strength will allow. Beef ribs are excellent for spinal grafts.

Having found great difficulties in bridging defects in one bone of the forearm by Lane plates or intramedullary grafts, Bancroft has used small bone fragments after experimenting on dogs in the following way: A piece of 3 cm. length is removed from the radius and the periosteum excised over the defect as well as 1 to 2 cm. over both ends. The excised bone is split lengthwise and all the endosteum removed. Then it is cut in small fragments of 1 to 2 millimeter width and these are inserted into the defect. Good union was thus obtained in 22 cases. Bancroft thinks that too much importance has been placed upon the origin of the bone cell as the vital factor in bone repair. Bone is mesoblastic in origin; in its repair calcium salts are deposited on the intracellular elements of connective tissue, forming new bone. The connective tissue cell by metaplasia becomes a bone cell. Periosteum is connective tissue, hence prone to form bone, but it is not the only connective tissue that has this function.

New Approach to the Hip Joint.

Smith-Peterson describes a new supra-articular subperiosteal approach to the hip joint as follows: An anterior incision is made from the anterior superior spine along the anterior border of the tensor fasciae latae to below the level of the trochanter. Then a curved incision is made from the anterior superior spine along the crest of the ilium, through the origin of the gluteus medius about one-half inch below the superior border of its periosteal attachment. When the skin muscle flap is freed from the ilium by subperiosteal dissection and the tensor fascia is reflected together with the flap the capsule is exposed and is entered above the ilio-femoral ligament.

The operation has so far been used in cases of congenital dislocation, for which it gives an excellent approach: but the author believes that also for other procedures, such as arthrodesis, his method is likewise of advantage.

Congenital Elevation of the Scapula.

Peckham has devised a new method for the relief of congenital elevation of the scapula. From a vertical incision between the scapula and the spinous processes, a wedge shaped piece of the trapezius is excised with base at the spine of the scapula. The lower angle of the scapula is drawn toward the spine and fastened with chromic catgut to the region of the tenth, eleventh and twelfth spinous processes. The result in the reported case has been very satisfactory; the shoulders are almost level and almost full elevation of the arm is possible.

Brooke's experience shows that a considerable damage may be done to the tibia by the removal of a piece of bone for a plastic operation. He has seen a fracture of the tibia in three cases where a grafting had been done for fractures of the upper extremity. The patients were allowed to walk after five weeks and the fracture of the tibia occurred from a very slight injury. In all three cases the removal of the graft had been done with a motor saw and without chiseling. Hence it would seem well in such cases to protect the tibia for a longer time, when weight bearing is allowed so soon after the operation.

Treatment of the fractured femoral neck has been the subject of frequent consideration and most observers recommend Whitman's abduction treatment as the method of choice at least for the early cases, both in adults and children, while they want to have the operative method reserved for certain fresh cases and for the old, ununited cases. The most remarkable contributions along this line are those of Albee and Brackett. Albee has perfected the bone grafting method which he calls glass stopper method. His technic is as follows: The fragments are properly adjusted from an anterior incision. Then from a lateral incision a canal is drilled through the subtrochanteric region, the neck and the head. In this canal is inserted a peg made of the tibia which fits exactly in the hole, like a glass stopper in the bottle.

Brackett has obtained very encouraging results in old ununited fractures by grafting the femoral head from the trochanteric region in the following manner: From a large flap incision the trochanter is exposed. The insertions of the gluteus medius and minimus are lifted up with a thin slice of bone and

the joint is opened. Then the trochanteric region of the femur is shaped to fit into a round depression which is made in the head. In abducting the femur one can now see the head move upon and with the shaft, usually to a surprisingly great extent. The leg is held in full abduction until the plaster cast is applied. No other fixation of the fragment is attempted than by exact suture of the capsule and the position of the leg in abduction. The glutei are fixed in place and the soft tissues sewed in layers.

Fat Embolism.

Caldwell and Huber report on an experimental study of the production and prevention of fat embolism due to trauma to bones. They found that crushing the tibias of mature rabbits produced a moderate and fairly constant amount of fat embolism as determined by counting the fat droplets in a large number of representative microscopic fields, in stained sections of lung tissue. Esmarch constrictors placed on the legs of rabbits, previous to the crushing of the tibias and removed after two hours, lessen distinctly the amount of fat entering the lungs during the remainder of the experimental period; this effect is much less marked and more uncertain when they are removed at the end of a half hour or even one hour. The amount of fat embolism which develops after the removal of the constrictors is dependent largely on the activity of the animals. Rabbits kept in chloral hydrate narcosis during the entire experimental period, following the crushing of the tibias, develop only a small amount of fat embolism although the constrictors are not used. The removal, by means of motor saw, of grafts from the tibia of normal dogs and rabbits produces an appreciable but very removal of the tibial grafts from dogs increases very slightly the amount of fat entering the circulation. The spinal part of the Albee bone transplantation operation, on normal rabbits, produces more fat embolism than does the tibial part.—*Leo C. Donnelly.*

A Clinical Study of Nerve Anastomosis. By Alfred W. Adson. *Annals of Surgery*, Vol. LXX, No. 2, August, 1919.

The author reports a study of forty-one cases of nerve anastomosis from the Mayo Clinic. A short review of the literature is given first. The report includes nine facial, seven ulnar, one radial, seven median, ten musculo-spiral, four external popliteal, two sciatic and one recurrent laryngeal. The suture material used was either fine silk or fine chromic catgut. 85.5% had end to end anastomosis; 19.5% had plastic flap operations. In 49% fascial covering of the anastomosis was used; vein covering was used in 10%.

The results were: 73% improved; 17% failures; 10% not determined.

The author summarizes: The regeneration of the peripheral nerves may be accomplished by nerve anastomosis. The degree of regeneration depends upon the duration of time between injury and repair, the actual loss of nerve tissue and the retraction of the nerve ends. In the technic of nerve repair no covering is necessary if the freshened ends can be sutured in close apposition; if an intervening gap remains it should be tubulized, preferably by fascia; if the gap is longer than five cm. tendon transplantation and arthrodesis should be con-

sidered instead of nerve anastomosis; autogenous transplants may be considered for short gaps, but they are of no greater value than tubulization.—*Murray S. Danforth.*

SURGICAL TREATMENT OF SCARS RESULTING FROM WAR WOUNDS. Walther. *Bulletin de L'Academie de Medicine.*

The author's subject is that of systematic removal of extensive scars, so often the cause of permanent disability in war wounds. The author maintains the view point that these scars should be dissected en masse, including the cutaneous scar. When dissecting the scar one must not neglect to prepare the skin backward very far until normal subcutaneous cellular tissue can be exposed. There is also the scar infiltration of the neighboring muscles to be considered. The entire fibrotic mass should be excised and wound prepared by end to end suture. Where the scar is very extensive the repair might be carried out in several stages. The author also recommends bathing of the tissue in normal saline solution during the operation, which also has a most useful hemostatic action.

No mention is made of a most important point; that is, the substitution of the defect created by the thorough resection and excision of the scar.—*Arthur Steindler, M. D.*